RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES
PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. 24 JUNE, 1935 NO. 6

RHIZOMONOMELORHEOSTOSIS

By BERNARD P. WIDMANN, M.D., *and* WILLIAM R. STECHER, M.D., *Philadelphia*

CHRONOLOGICAL REVIEW OF LITERATURE

THIS entity was first recorded in the literature by Leri and Joanny (14), in 1922. Their patient, a female, age 39 years, presented herself for examination, to determine the cause of a bony deformity of the left hand; namely, a divergence of the second and third digits, which she ascribed to a fall at the age of 17. A constant dull pain, which was particularly marked nocturnally, commenced approximately eight years prior to the present examination. Several deformities of the upper extremity, left side, associated with limitation of articular motion, were observed clinically. Roentgenographic examination disclosed complex and unique limitation of new osseous formation, to definite portions of the entire single upper extremity. There was conspicuous demarcation between the normal and abnormal osseous development, which presented a peculiar irregularity of contour of the cortical width. The fancied resemblance of this hitherto undescribed process to the appearance of dripping wax along one side of a candle, suggested the name, "hyperostose 'en coulée' sur tout d'un membre" or melorheostose; *viz.*, a candle-flow, streaming itself the entire length of an extremity. Unable to establish an etiologic factor for this rare osseous condition, they considered it to be a developmental defect. Curiously, this original supposition we consider to be the most probable, after much speculation and theorizing by the various authors.

An analogous case was next reported in 1925, by Lewin and MacLeod (19), who independently recorded the lesions as an "unclassified osteosclerosis." Their patient was a 35-year-old male, who had noticed peculiar swellings in two of his fingers of the right hand, and dated the onset of this condition at the age of six years. A few years after their recognition, similar thickenings of apparently osseous density were noted in the right elbow region. Dull and rather constant pain had been present since the age of 10, and the deformities and limitation of articular movements became progressively worse. Roentgenographic examination revealed: increased osseous production, eburnation and sclerosis, with almost complete disappearance of the medulla, resultant of encroachment on the canal by the hyperostosis. The cortical outlines were obliterated along the lateral aspect of the ulna, triquetrum, pisiform, capitate, fourth and fifth metacarpal bones, and the phalanges of the fourth and fifth digits. No definite causative factor suggested itself, and the distribution of the lesions intimated a neurotrophic derangement along the course of the ulnar nerve.

Muzii (27), in 1926, reported a similar type of bone involvement in a 10-year-old girl, who had complained of swelling of the left knee region, and seeming shortening of

this entire extremity since the age of five. Examination disclosed the process of hyperostotic development to have extended from the superior ramus of the left pubis, along the acetabular brim, femoral head, medial aspect of the femoral diaphysis, medial femoral condyle, patella, tibia, talus and all the lesser bones of the medial one-half of the foot, inclusive of the first digit. The lesions were characterized by hyperostosis, with occasional regional discrete sclerosis. Strangely, there was a coincidental finding of "cranio-stenosis," but, Muzii did not attempt to classify or suggest an etiologic factor for his case.

One year later, Putti (29) reported a case of an 8-year-old girl, who had a deformity of the left foot, which had previously been considered as an ordinary pes valgus, present since the child was 11 months old. One year previous to the roentgenographic examination, the child had complained of pain in this foot. Clinical study revealed shortening of the left leg, with a slight degree of genu valgum, and 4 cm. increase in the diameter of the left knee region. The lesions were typically osteoblastic, and the hyperostosis involved the acetabular lip, skipped the femoral head and neck, affected the greater trochanter, lateral aspect of the femoral diaphysis, lateral femoral condyle, sparing the knee joint, and continuing along the lateral aspect of the tibia, talus, calcaneus, and third cuneiform bones. Putti obtained a biopsy from the affected femoral shaft region, and his histopathologic report was essentially as follows: conspicuous obliteration of the vascular lumina; increased vascular pattern, with perivascular ossifications, and atrophic marrow, containing few osteoblasts and numerous osteoclasts. His impression was that the vascular obliterative process was secondary to local sympathetic contractions, and the osteogenetic changes then ensued therefrom. Policard, of Lyons, reviewed the tissue sections, and considered the degenerative process as primary and the condensations secondary, with the vascular obliterations as merely coincidental findings. Putti termed the condition "l'osteosi eburneizzante monomelica," and similarly was unable to establish a primary etiologic factor.

Zimmer (39), Perussia and Meda (20) independently reported additional cases of this curious condition, in the year 1927.

Zimmer had examined a man of 32 years, who presented hyperostotic involvement of the left acetabular lip, entire femur, inclusive of head and neck, lateral aspect of the diaphysis and lateral condyle; sparing the knee joint; affecting the fibula, talus, calcaneus and third cuneiform, and third and fourth metatarsals. He considered this entity of what he described as aligned osseous densities, to be resultant of embryonic metameric disturbance. Kauffman (9), reviewing the biopsy sections, reported compact trabeculations, normal Haversian canals, and fibrosis of the bone marrow, which contained islets of active osteoblasts.

In an article considering osteitis deformans and its differential diagnosis, Meda described a case of unstated age and sex, in which the condensations were present on the lateral aspect of the distal humerus, entire radius, central carpal bones, second, third, and fourth metacarpals, and corresponding phalanges. He mentioned that this case presented definite limitation of articular movements and deformity of the affected right upper extremity.

Valentin (37) next reported a complete continuous type of hyperostotic flow in a 17-year-old female, commencing in the region of the right glenoid cavity, and terminating in the second digit. He attached particular importance to the endosteal hyperostosis, causing encroachment upon the normal medullary canal. Clinically, the patient was unable to completely and freely extend and flex the elbow, wrist, and index finger joints; and additionally, there was present distinct angulation of the affected digit, resembling the original reported case of Leri. The onset of the process could be traced to the age of 2 years. Notation was made of absolute shortening of the affected extremity and soft tissue atrophy of the right forearm, there being, comparatively, 2 cm. less circumference.

Meisels (22), in 1928, reported a rather typical case of melorheostosis, involving the right lower extremity of a 25-year-old female. Meisels emphasized a rather characteristic finding in the condition, namely, absence of the process at the levels of duplication; *viz.*, the tibia presented no pathologic changes, the involvement being confined to the fibula. The distal femoral epiphyseal region was affected, with typical evasion of the knee joint, and further involvement of the proximal two-thirds of the fibula. Since the pain complained of by the patient was of a dull aching character, and further considering the prevalence of malaria in the marshy region where the patient resided, he seriously considered this entity as being a manifestation of a malarial infection. Subsequent clinical and laboratory investigations did not lend support to this supposition. Meisels, in attempting to explain the relative shortening observed in certain cases, propounded an ingenious theory: if the pathologic process involved the temporary zone of calcification *prior* to the completion of ossification, there would necessarily result a retardation of growth of the extremity, but if the osseous condensing over-growth of bone occurs in the identical relative site *after* the epiphyseal line has disappeared, no growth restraint could be manifest, but instead, interlocking effect of the articulations and even mechanical bowing of the involved bones might result. However, relative to this hypothesis, the authors and other observers have noted this shortening of the affected extremity, with associated soft tissue atrophy, prior to any discernible invasion of the epiphyseometaphyseal juncture. Goldschlag (6), in reviewing this case, suggested an endocrine dysfunction as an etiologic factor, inasmuch as the patient presented trophedema of the extremity, and rather distinct clinical evidence of hyperthyroidism and hypo-pituitarism. The possibility of these being merely complicating and unrelated entities is none the less to be borne in mind, as this was the only case reported in which enlargement rather than atrophy of the surrounding soft tissue was connoted.

Leri and Lievre (15, 16, and 17), after carefully studying their originally reported case over a period of six years, reported development of new osseous condensations, which was the first absolute roentgenographic proof of the progressive nature of the process. This osteoblastic progression was manifest in the soft tissues, in the muscle tissue of the infraspinatus region of the scapula, and the other, seemingly detached from the second rib site close by. These osseous masses were removed and examined, and were shown to consist of average appearing Haversian canals and marrow which appeared extremely cellular, containing increased numbers of osteoblasts and osteoclasts. No vascular obliterative changes with associated perivascular condensations were reported, as Putti had observed, but instead, there was prominent vascular hyperplasia, with concomitant active ossification occurring in numerous scattered islets of cartilage. These detached islets of bone, they considered as being the end-products of embolic dissemination of released osteoblasts, possibly by some undetermined infectious agent. Upon this rather hypothetical premise, they discarded their original theorization of congenital developmental defect, and accordingly considered the process as being of post-natal origin, probably from 5 to 20 years' duration, and then developing insidiously and progressively until pathognomonic linear distribution of the irregular condensations for a portion or entire length of derivative of an anlage of an extremity occurred. Unless the condition were aggravated by superimposed trauma, the commonly associated symptoms of dull and fugacious osteocopic pain might readily be entirely overlooked.

In 1929, Kemkes (10), reported a case of a 54-year-old machinist, that, parenthetically, is the oldest patient on record, who had complained of dull intermittent pain and slight wasting of the upper right extremity since the age of 42. Recently, loss of cutaneous sensibility was complained of. The osseous lesions corresponded to the continuous single flow variety, commencing in the

right scapula and descending along the lateral aspect of the humerus, radius, lateral row of carpal bones, and phalanges of the first and second digits. The articulations appeared locked by many hyperostotic processes. Kemkes concurred with Zimmer relative to the theory of the etiology being that of a congenital metameric disturbance. An interesting contribution was the explanation and justification of the qualifying word "monomelic," which, it was argued, should not be discarded, inasmuch as the term "melic" inferentially applies to the anlage or root from which the extremity is derived, and which accordingly might and did include large portions of scapula, ribs, thoracic vertebræ, pelvic bones, inclusive of the fifth lumbar vertebra. Unfortunately an additional qualifying word was not advocated, to include the specification as to derivation from an anlage.

Milani (26), in 1930, reported a case of melorheostosis of the interrupted flow variety, in a male patient, whose age and date of onset of symptoms were not stated. The right lower extremity was involved by the hyperostotic process.

Leri, Loiseleur, and Lievre (18), in the same year, 1930, conjointly added another case of melorheostosis to the literature. They had examined a 39-year-old clergyman, who had been given repeated courses of anti-syphilitic treatment, in the form of bismuth and sulpharsphenamine therapy, for the preceding ten years. This had been administered because of the type of pains, namely, sharp pains in the wrist joint, which were aggravated upon motion and were especially nocturnal and osteocopic in nature, and were becoming progressively worse. No positive complement fixation test was obtained relevant to the assumed syphilitic origin. The information was forwarded by the patient as it had been told to him that, since infancy, his middle finger had been stiff. As was to be expected, in retrospect, no relief of symptoms was obtained by the anti-syphilitic treatment, and curiously the pain had abated somewhat during the summer season. The hyperostosis involved the right upper extremity, commencing at the scapula and extending interruptedly to the second and third digits. Comparing their second case to their original case report, the authors noted common characteristics of osseous flow, a tendency to spare the joints, and effect only in certain regions of bone in which osseous duplication occurred; *viz.*, the radius being intact and the ulna affected. A biopsy obtained from the third metacarpal bone presented negative bacteriologic studies, and the microscopic appearance was that of apparently varying phases of intermingled rarefaction and condensation, with predominance of the latter. These areas of condensation showed decrease in both size and number of Haversian canals, and the rarefactive zones presented conspicuous absence of osteoclasts. There was no demonstrable evidence of inflammatory reaction or vascular hyperplasia, but, rather, actual absence of newly formed vessels and evident lack of customary sanguineous ooze, upon sectioning the gross tissue. The authors concluded that there was an initial resorption of bone and resultant areas of rarefaction and then further excessive reossification. No etiologic factor, again, was determined. An experiment was performed in an attempt to determine the ability of this curious newly formed osseous tissue to continue its growth and reproduction when transplanted. Accordingly, a section of biopsy material removed from a characteristic involved site was transplanted superiosteally upon the femur of a monkey. Should this "graft" continue to grow, their theory of "affection parasitaires," *i.e.*, embolic osteoblastic formation, would be supported. The experimental femur was carefully studied over a period of eight months and no evidence of new bone formation was definable and there was complete absorption of the graft.

Kahlstorf (8), in the same year, reported a case of melorheostosis occurring in a man 33 years of age, who had been complaining of dull aching pain for three years prior to the examination. This case was that of the typical interrupted flow type, and was present in the left lower extremity.

Junghagen, in 1930 (7), recorded an excellent presentation of melorheostosis. His patient was a farmer, who had been complaining of vague rheumatoid pains since childhood, which progressively and recently had produced marked limitation of articular movements of the entire right upper extremity. In addition, loss of muscular strength was complained of by the patient at the time of examination. The lesions were found to extend from the scapula to the tip of the third digit, in an interrupted flow fashion. The process characteristically spared the entirety or portions of certain bones, and the joints. There was a distinct tendency toward obliteration and invasion of portions of the spongiosa, this hyperostosis being mainly endosteal. A section was obtained from the involved olecranon process of the ulna. There was no microscopic evidence of inflammatory change, which again added to the weight of evidence against any possible infectious nature of the process, *i.e.*, an osteo-periostitis. The general appearance of the section was that of osteosclerosis, with typical compact bone lamellæ, with various angled interlacing trabeculations. The Haversian systems appeared of average normal description, though very slightly diminished in caliber. There was slight but definite decrease in both absolute and relative number of osteoblasts and osteoclasts. The vascular bed presented no abnormal changes. Delving deeply into conjecture regarding etiology, Junghagen proffered the following suggestions:

(1) The limitation and relatively slow progressive nature and development of the process, which was definitely limited to derivation from a single extremity anlage, together with negative complement fixation test for syphilis, militate against any theory of a local organic or even systemic disease, including leukemia, lymphosarcoma, etc.

(2) The lesions resemble the atypical appearance of osteosclerosis of Albers-Schönberg, and even osteitis deformans of Paget, but nonetheless constitute a distinct separate entity, which is readily differentiated by careful perusal of the roentgenograms, study of the distribution and structure, and finally, the histopathologic appearances, the latter being irrefutably dissimilar.

(3) The theory propounded by Zimmer appears the most rational, as this explains the protracted progressive development of the lesions—clinically encountered or at least inferred from the anamnesis. The lesions appear to be comparable in development to the rate of normal osseous growth.

(4) The local ischemic theory of Putti, and the neuropathic hypothesis of Lewin and MacLeod, patently do not explain the distribution and appearance of the lesions in all the reported cases; for careful perusal of the recorded distribution of the lesions, in the main, did not affirm the regional distribution of the neural segments, and other reliable observers presented diametrically opposite reports relevant to the microscopic tissue study.

(5) The limitation of articular movements is perhaps most likely resultant of mechanical interference by the osseous excrescences resembling exostoses, and is seemingly analogous to osteophytic spur formation concomitant with hypertrophic osteo-arthritis. However, there are observers who justifiably doubt the explanation of the articular motion restriction to be resultant of arthritic changes.

In 1931, Piergrossi (28) presented a case of melorheostosis, which would have disrupted the propriety of the monomelic designation had not the explanation of the derivation of an anlage of a single extremity been proffered previously. His case was that of a 36-year-old male, with characteristic hyperostotic lesions involving the right ilium, ischium and pubis, including the acetabular region. All these sites were massively involved, and the process was less extensive as it descended along the lateral aspect of the femur. The fibula was markedly involved and bowed. Rather typically, the tibia was therefore uninvolved. The lateral row of the tarsal bones, metatarsals, and phalanges were similarly involved. The patient was of the conviction that the lesions were the result

of a severe whipping when 14 years of age and a crush injury to the same leg and ankle region 4 years subsequent thereto. A few years prior to the reported roentgenographic examination, the patient had complained of dull pain of an osteocopic nature, associated with limitation of both hip and knee action, and was exempted from military service. The hip and knee joints roentgenographically presented a typical appearance of mechanical ankylosis, but no actual fusion. Piergrossi stressed the appearance of interspersed areas of rarefaction and heterotopic ossification. He considered the following differential diagnoses: (*a*) Osteopetrosis (marble or chalk bones of Albers-Schönberg); (*b*) Osteopoikilosis (spotted bone, due to disseminated bone islets in the spongiosa of the skeletal system of bones of non-membranous origin); (*c*) Osteitis deformans (Paget); (*d*) Osteitis fibrosa cystica (von Recklinghausen)—atypical form; (*e*) Congenital or acquired syphilitic osteo-periostitis; (*f*) Progressive myositis ossificans and fibrositis ossificans fasciæ. He did not subscribe to the developmental defect theory of Zimmer, and favored the local ischemia hypothesis of Putti, with some degree of modification, as follows: primary simple osteosclerosis with practically no change in the contour of the bones, and secondary, periostosis with marked deformity of the osseous contours predominating. The authors are of the opinion that it was most unfortunate that the term "periostosis" was substituted for "hyperostosis," inasmuch as the latter is the correct terminology, and includes both periostotic and endostotic forms, which are frequently concomitant findings.

Rokhlin (31), in 1931, reported a case of monomelic flowing hyperostosis, which presented characteristic findings as contrasted with previously reported cases. His patient was a female of 25 years, with slight involvement of the left upper extremity, the lesions being limited to the medial humeral condyle, ulna, capitate, and the middle and distal phalanges of the third digit. The salient features of the condition, namely, alignment of hyperostotic lesions, with absence of articular involvement, and normal appearing intervening osseous structure along the course of the designated "flow," were present.

The following year, 1932, Weil and Weissman-Netter (38), reported a case of "rheostosis" in an army officer, 37 years old, who had been clinically considered as having had malaria and associated polyarthritic attacks at repeated intervals. The history also included pulmonary tuberculosis, and various traumas, which in retrospect had distracted attention from the osteocopic nature of the pain complained of in the right upper extremity. This case proved to be of unusual interest inasmuch as the hyperostotic lesions apparently transgressed the confines of an extremity, which heretofore had been considered as pathognomonic. There was involvement of the fourth rib throughout its entire extent, including its vertebral insertion; the humerus, a few carpal bones, and complete lack of involvement of the radius and ulna. The authors accordingly advocated revision of the current term "melorheostosis" to "rheostose," which would not limit the lesion to one extremity. Again, embryologists brought forward the explanation that the involved limb, and what the writers had considered entirely unrelated contiguous bones, were or could be derived from an anlage for the extremity, which, they explained, occasionally includes the adjacent structures mentioned.

In 1932, interest in this condition was revived by Kraft (11), when he reviewed the literature and added two new cases, one, a 40-year-old male, in whom characteristic lesions involved the left upper extremity. There had been a history of progressive development of the process since the age of 22. Initially, a palpable tumefaction was noted in the left infraclavicular region, together with a rather firm nodule, seemingly attached to the radial aspect of the wrist region. At the age of 30, an irregular thickening of the second digit developed, and at 33, there was an enlargement of the humerus. Three years subsequent thereto, the thumb

had become insidiously thickened, and enlarged irregularly. Three years prior to reporting of this case, parasthesia and other evidences of nerve and muscular weakness were manifest. Both the physical and roentgenographic examinations were pathognomonic of flowing monomelic hyperostosis at this time, as manifested in irregular nodulations of osseous density in the soft structures of the left shoulder girdle, which strongly resembled osteophytic spur formations from the contiguous bone, the one projecting from the costochondral articulation of the first rib, and slightly distant from the affected limb. There were varying degrees of decalcification and eburnation in the affected extremity, which, with associated curvature of the bones comprising the right uninvolved forearm, led the author to consider the entire appearance as resultant of a developmental disturbance.

The other case of Kraft was a female, 37 years of age, who dated her initial symptoms of pain and limitation of motion of the right hip joint from the age of 23 years. At that time, after considerable study, the process was diagnosed as a low grade osteomyelitis or ossifying periostitis. There was associated leukocytosis of 14,000. The symptoms abated after a short period of disability, without operative intervention, and slight limitation of motion in the hip joint remained. Seven years later, a rather similar recrudescence of symptoms developed, and careful investigation disclosed the presence of monomelorheostosis of the partial continuous flow type, limited to the acetabular and femoral regions. Kraft favored the endocrine dysfunction etiology, and stated that this should be considered until further studies show a more likely etiologic factor. He suggested roentgen therapy, but no intimation of evaluation was given.

Kraft (12), in a review of the pathology of melorheostosis, described an additional case observed by Sante in about 1923. This patient was a male, who presented roentgenographic evidence of a circumscribed flow of hyperostosis limited to the fourth metacarpal bone, right hand, and the apposing proximal phalanx. Studies of this region twenty-one months later demonstrated no discernible changes, the process being considered as stationary or quiescent. Unfortunately, the patient never returned for further study and an examination of the entire extremity was never obtained.

In September, 1932, one of the authors, while attending the Bone Tumor Conference at Johns Hopkins University, heard Dr. B. M. Parmalee, of Bridgeport, Conn., present a case of melorheostosis, occurring in a female 23 years of age, who had been examined elsewhere previously and diagnosed as ossifying periostitis of the right pelvis and proximal portion of the right femur. This case emphasizes a most important point, namely, in any hyperostotic lesion of any part of an extremity, always radiograph the entire extremity. Unquestionably, had this procedure been carried out, the diagnosis would have readily been made, because the appearance of the disease is so pathognomonic that the most important single factor is that of keeping the possibility of this entity in mind. At the time of the initial roentgenographic examination, the patient had been suffering from what was termed rheumatoid pains in the right hip region for the preceding five years. These symptoms of dull aching pain and limitation of motion of the hip joint became progressively worse, and after gestation became wellnigh intolerable. The case presented a very typical picture of the continuous hyperostotic flow, from the right sacro-iliac synchondrosis to the terminal phalanges.

Saupe (33), in 1932, presented an additional case of melorheostosis in a woman aged 27, one of a family of eight children, in whom no osseous pathologic changes were observed aside from scoliosis in two. The parents likewise presented average roentgenologic findings. As a child, the patient had noted a swelling of the ulnar aspect of the second digit, left hand; although painful when firm pressure was applied, it did not interfere with any

activities. The present symptoms began about twelve years previously, following trauma to the third digit of the same hand. The radial aspect of the finger became swollen, the swelling gradually extending to the wrist region. Soon thereafter, she became cognizant of some degree of impairment in motion of the left elbow joint, and soon constant dull pain, of an aching character, became manifest, which was of nocturnal osteocopic nature. The slightest trauma to the affected region elicited marked tenderness. Nodular thickenings were palpable along the first and second metacarpal bones, left side. Mensuration disclosed a difference of 2 cm. in the peripheral measurement of the mid-hand region of the left hand; slight thickening of the left elbow region, and 2 cm. shortening of the left forearm. There was restriction of articular movements of metacarpo-phalangeal joints of the second and third digits, limitation of motion of the left wrist joint, and ankylosis of the left elbow joint, in position of flexion, with no disturbance of the left shoulder articulation. The complement fixation test for syphilis was negative, and no laboratory findings suggestive of tuberculosis were found. The patient's menstrual history had always been irregular, but no further evidence of endocrinal dysfunction was detectable. The roentgenographic findings were characteristic of melorheostosis of the partial continuous flow type.

In 1933, Moore and de Lorimier (25) contributed another case of this rare entity to the literature. Their patient was a man 38 years of age, with a negative family and personal history. The onset of the complaints occurred with swelling of both feet and ankles, associated with a dull ache extending into the calf muscles. This was first observed by the patient during the World War, while he was digging trenches in France. When discharged from the service he was rated 10 per cent disabled due to pes planus. In 1922, on account of lancinating pains in the upper thigh region, a roentgenographic examination was made which disclosed "marked density of bone in the region of the greater trochanter of the left femur; spine and hip joints negative." The pains continued unabated, however, in spite of treatment. In the three years prior to the reporting of the case, the pains became progressively increased and well-nigh "unbearable." There was increased muscular weakness and atrophy of the muscles of the thigh and leg regions, with limitation of motion in the entire extremity. Clinical examination revealed perceptible roughening and prominence of the proximal portion of the femur, comparative diminution in circumference of both the mid-thigh and calf regions of the affected side. All laboratory findings, which were carefully and extensively performed, were essentially within normal limits. A complete skeletal roentgenographic examination was made, and these studies revealed the following: an interrupted type of hyperostotic flow, extending from the greater femoral trochanter to the calcaneus, with selective affinity where duplication of skeletal support existed, namely, involvement of fibula and sparing of tibia. At certain areas the lesions resembled disseminated osteites. Throughout there was some degree of endosteosis encroaching upon the medulla, with occasional areas of cortical erosion. Lateral bowing of the femur and postero-medial curvature of the affected fibula were evident.

In an excellent review of the numerous etiologic theories promulgated, these authors suggest a non-infectious osteitis, secondary to subperiosteal telangiectases; for acceptance of this hypothesis would explain the seemingly divergent histopathologic reports, upon the basis of description of actually the same process at various stages of progress; *viz.*, the initial stage as seen by Leri; intermediate, by Putti, and the terminal effects by Leri, Loiseleur, and Lievre. Thus, correspondingly, the telangiectasis with ensuing hemorrhage is causative of vascular obliteration, which, in turn, produces increase in newly formed vascular tissue (hyperplasia) —a vicious circle, tending to explain the

cortical erosions with following ossifications, all resultant of subperiosteal hemorrhages. Unquestionably, an exact determination of this supposition would be of immense importance, inasmuch as roentgen therapy should prove to be of great benefit; possibly arrest the disease in its early stages, and cure, within the realm of possibility.

Of the three hypotheses offered to explain the bowing of the involved bones, they consider the theory of unequal tension of muscle groups due to selective muscular asthenia and atrophy the most probable. However, it must be admitted that which is cause and which effect, cannot definitely be decided. Other considerations were: undue strain for hypoplastic type of bone, and the result of mechanical leverage effect of hyperostotic processes.

Schor and Heinismann (35), in the same year, reported two cases which they considered as representing what has been described as melorheostosis, in its early phase of development. The one patient, a 20-year-old male, had complained of thickening and interference of motion in the region of the metacarpo-phalangeal articulation of the first digit, right hand. This condition persisted without definite pain for one year. Roentgenographic studies showed involvement of the metacarpal and phalanges by a hyperostotic process, which was both endosteal and periosteal in type. In addition, both sesamoid bones in this site were affected by rather similar changes.

The other case described, a young male, had the symptom of pain in the right radiocarpal articulation. No deformity or actual impairment of movement was demonstrable. Radiographic examination revealed partial sclerosis of the second metacarpal bone, with encroachment on the spongiosa in the proximal metaphyseal region, which markedly narrowed the medullary space at this site. The remaining skeletal system of both patients was of average normal description.

The reports of Sicard, Gally, and Haugenau (34), Froelich (3), Rendu and Gay (30), Kahlstorf (8), and Milani (26) have been included by some writers as variants of this condition, and by others as truly infectious lesions, and therefore have not been alluded to in this review.

Including the authors' case report, a summary of all the reported cases of rhizomonomelorheostosis discloses that the ratio of males to females is as 16 to 9; and the predominance of right to left side is as 15 to 10. The United States leads with number of cases reported, there being a total of seven; Germany contributed six; Italy, five; France, three, and one case each from Poland, Sweden, Russia, and Switzerland. The average age is 25 years, but the most frequent age-period is from 30 to 40 years. The authors' case is the youngest case reported (a patient 6 years old), and the oldest case reported is that of Kemkes, whose patient was 54 years old.

TERMINOLOGY

In deciding upon a descriptive name for this entity, it is important to arrive at a definite conclusion as to whether all the reported cases should be considered as the same process, namely, as a hyperostosis, regardless as to whether there was predominance of, or solely, periostosis or endosteosis, respectively. The prevailing opinion—and in this the authors concur—is that they are both phases of development of the same process, and probably the degree of predominance of either type might be a clue as to the degree the lesion has progressed, but not actually the age of the lesion. It seems relevant that, in the majority of the cases reported, when the patient was relatively young there was predominance of endosteal involvement, but this was also not without exceptions. From this observation, it seems justifiable to infer that endosteal proliferative condensation is the earlier manifestation of the disease, with increased periostotic involvement concomitant, but procrastinated in actual demonstrable development. Since many observers have shown the two processes to be chronologically associated occurrences, it is perhaps best, with our

present knowledge of the entity, to consider these related conditions under the same categorical heading, and not attempt to differentiate the age of the lesion relative to degree of hyperostosis or type of involvement.

Various names have been applied to the condition, *viz.*, Leri's disease; melorheostosis Leri; osteopathia hyperostotica congenita unius membri; osteosis eburninans monomelica; monomelic flowing hyperostosis, and the recent proposal of Weil and Weissman-Netter, to change the name to "rheostosis" (because in their case, not only was the limb (*melos*) involved, but scapula, and thoracic vertebræ and ribs), and refer to other cases wherein the pelvis and lumbar vertebræ were affected. However, embryologists discount this distinction, if one accepts that the involvement is related to the derivatives of an anlage or root of a single extremity, which includes these apparent exceptions. Accordingly, the addition of the qualifying word "rhizo" (*root* or *anlage*) of an extremity is deemed advisable. Again, since the condition has never been observed to involve more than one extremity, it seems patent that the name must retain a qualifying mono- (single) appelation. Since the process is agreed by all observers to be a hyperostosis including both or either the periosteal or endosteal type, which is analogous to flowing bone, the descriptive term "rheostosis" (*running bone*) is an excellent one. Unfortunately, no etiologic factors have been agreed upon, and even though the congenital assumption is the most plausible, insufficient evidence has accrued to justify inclusion of *congenital* in the name. Thus, recapitulating the different components, the names "rhizomonomelorheostosis," or "rheostosis rhizomonomelica (congenital)," are offered by the authors.

ETIOLOGY

Numerous theories have been propounded as causative factors in the production of this entity. Leri considered the possibility of an infectious agent, but in spite of many attempts on his part and others at bacteriologic isolation, all the experiments thus far have been unsuccessful. Even though histopathologic studies are suggestive of an osteitis, as manifest by a distinct cellular reaction, nevertheless, the absence of systemic symptoms of toxicity and fever, leukocytosis, and other concomitant phenomena, together with bizarre selective affinity and osseous involvement in linear fashion, and constant sparing of the articular sites, all together rather conclusively preclude such an inference.

The neuropathic hypothesis had a few adherents, but no actual proof of the same was in evidence, and most of the cases recorded presented conflicting involvement as regards neural pathways. Putti was the sponsor of the theory of secondary vascular obliterative effects to primary local sympathetic nerve system involvement, with capillary contraction and angiospasm. Thus, there was ensuing osseous eburnation along the course of the nutrient vessels.

Constitutional, endocrinal, and hereditary factors have been suggested, but no unanimity of opinion is established as to their respective merits. The majority of cases reported presented no clinical evidence of endocrine dysfunction. Careful studies in other members of the family showed no involvement, other than the case originally diagnosed.

The infectious granulomas, particularly syphilitic and tuberculous, as causative or even contributory factors, have been rather completely eliminated by laboratory examinations. There never has been suggestive evidence in both the microscopic appearance and clinical course of the disease to suggest, as a remote possibility, a neoplastic nature, either benign or malignant.

Zimmer propounded a very rational explanation, as is observed in reviewing the entire literature concerning this entity. He proffered the embryonic theory of metameric disturbance. This inference is adhered to by the authors and others, and although no case has been shown to have occurred since birth, *i.e.*, roentgenographic

demonstration, yet, on occasions, the deformity has been noted since birth, and the inference must be that the osseous changes noted later in life were causative originally for this deformity. The gradually increasing soft tissue atrophy and lack of complete normal osseous development coincides, as would be expected, with what would occur in ordinary delayed bone growth.

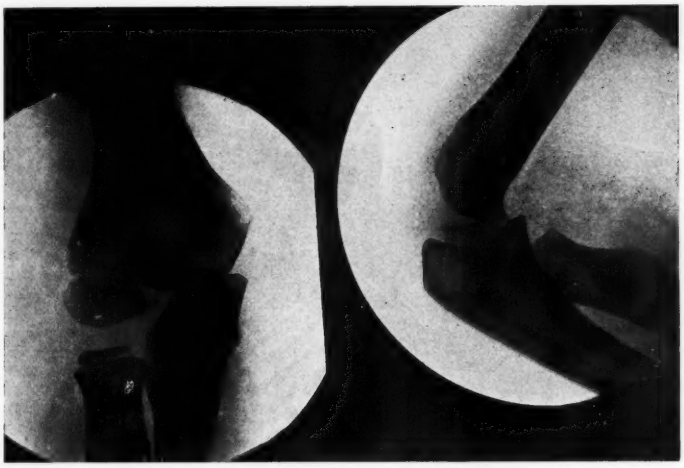


Fig. 1. Original roentgenogram of left elbow region, from which a provisional diagnosis of melorheostosis was ventured. Note the definite hyperostosis of the distal end of the humerus and proximal portion of the radius.

Moore and de Lorimier suggested subperiosteal telangiectases, which might arise either congenitally or developmentally, and give rise to petechial hemorrhages, thereby producing vascular obliterations which, in turn, would excite further telangiectasis. The osseous changes are reaction to the hemorrhage.

One can conclude, from a perusal of the many theories offered, that none explains all the peculiar characteristics of the process, and that many more cases must be found and carefully studied in the light of the prior theories.

PATHOLOGY

There is a paucity of literature concerning the pathology of melorheostosis, for in only five cases were biopsies obtained, and as yet none have come to autopsy. It is apparent, therefore, that considerable of the pathologic interpretation has been made only from the roentgenographic findings, with comparative estimates to proven osseous changes which resemble the former.

The essential findings are those of cortical hyperostosis, which consists of dense sclerotic bone, and is either endosteal or periosteal in site, or both. The nature of the lesion is benign and progressive, causing expansion and enlargement in the cross-section of the bone. Although the inherent tendency of the process is toward aligned lesions, which resemble "coulée de bougie" (candle-flow streaming) itself, yet in the pure endosteal type of melorheostosis, no truly defined expansile enlargement of the bones involved is noted. On the contrary, relative and absolute osseous atrophy, particularly in length, has been a rather constant finding, which resembles osseous growth restraint. Most of the cases reported, presented some degree of medullary encroachment by the eburnizing cortical hyperostosis, attesting to the common coincidence of both types of hyperostosis.

In all cases described, the distribution of the lesions was unique in that the derivatives of a single extremity anlage were

affected. Occasionally, seemingly isolated compact islands of bone resembling endostoses have been observed.

Fig. 2-*A*. Note the relative soft tissue atrophy of the left wrist and hand regions. The hyperostosis involves the entire first digit, metacarpal, and the entire greater multangular.

Kraft attempted to classify the lesions according to their extent, and differentiated between the following:

1. Complete continuous flow (far advanced stage);
2. Partial continuous flow (advanced stage);
3. Interrupted flow (advanced stage);
4. Circumscribed flow (early stage).

This classification is excellent, relevant to degree and type of anatomical involvement, but the assumption that the duration and degree of pathologic change is certainly not proven and very questionable. According to it, the authors' case would be considered under Group I, which is deemed as far advanced; and yet the anamnesis, clinical data, and roentgenographic findings are diametrically opposed to this inference. It is perhaps more logical to consider the amount of hyperostosis, and particularly periostosis, as the criterion of the degree of pathologic development. The supposition made by the authors is that endostosis is the earlier development, and that as the lesion progresses, increased hyperostosis continues to increase the width of the eburnating cortex. Furthermore, it is very doubtful indeed if the grouping presents different stages of the entity, for insufficient data have accrued to testify as to the transformation or progress of one group to the other. The common denominator of the various manifestations of the process is its progressive nature, uninfluenced by therapeutic means at our command and present knowledge. This course has been shown in practically all the clinical histories and actually in a few roentgenographic confirmations.

Group I. Complete Continuous Flow.— This is the rarer form of the disease, and is characterized by hyperostotic extension over the entire extremity, or perhaps better qualified, the derivation of the anlage of one extremity. Dense, osseous tissue, resembling cortical bone, extends as a complete continuous flow from the scapula

or innominate bone, respectively, to corresponding digits. The hyperostotic involvement is most frequently of the periostotic type, but this may be accounted for by the fact that the vast majority of the reported cases was found in mature individuals. Both the periostotic and endostotic flow are typically of irregular sinuous contour, which simulates the course of nerves and blood vessels, but is never actually restricted to their sites. There are occasional ridge-like processes paralleling the long axis of the involved bones.

Group II. Partial Continuous Flow.—The features of Group I are present, but with limitation of the lesion to approximately one-half of the extremity. In those cases in which the course of the process has been carefully observed over a period of many years, the pathologic entity has not presented any demonstrably increased extent, contrasted with the original examination. The hyperostosis was, however, increased at times, but inconstantly. This phenomenon would lead one to believe that the process from its inception is limited or potentially present at a specific site, and the process, therefore, does not involve any other region or area than its predestined site, its extent being confined to degree of hyperostosis. This belief would strongly favor a congenital defect etiology.

Group III. Interrupted Flow.—The hyperostotic involvement is interrupted in several sites, the flow *per se* being of either the periostotic or endostotic variety, or both.

Group IV. Circumscribed Flow.—In this type, the proliferative cortical bone is confined to one metacarpal or metatarsal and a contiguous phalanx. These processes, in the main, have remained stationary over a period of years. The case of Leri, Loiseleur, and Lievre is the only one in which actual roentgenographic evidence was established, showing hyperostosis occurring after an interval of a few years, in what was previously considered a normal humerus. This, however, must not be misconstrued as proving that a circumscribed type of flow has been transformed or progressed into an interrupted flow, inasmuch as it might conceivably be that the process was dormant and latent, but potentially present from the outset, and through some unknown factor stimulated to development.

Piergrossi (28) considered the development of the disease as occurring in two successive phases. The first phase, primarily osteosclerosis, with slight enlargement and regular contour of the bones, would correspond to the circumscribed type in Kraft's classification. The second phase was considered to be present in adults, and as representing an advanced stage of the former, and as being characterized by considerable irregular enlargement of the involved osseous structures, due to periosteal cortical proliferation, *viz.*, periostosis. These observations are significant, and represent in part the authors' deductions, namely, it is probable that the earlier manifestations of the process are, in the main, endosteosis, and the later forms, endosteosis and predominating periostosis.

A constant feature of the disease is sparing of the joints, and only in the exceptional case was there ankylosis noted, and then it was a result of pseudo-bridging by osteophytic excrescences, and not true arthritic changes.

Although superficial analysis would suggest a similarity to osteopetrosis or so-termed "marble bones" of Albers-Schönberg, the compact bone in melorheostosis presents no proclivity to fracture. This is an important differential point in addition to the lack of generalized osseous involvement.

Occasionally, heterotopic osseous formations appear as partly confluent masses in the soft tissues, either in the muscular structure or subcutaneously. These bizarre condensations have been noted only in the shoulder or pelvic girdles. This formation can be explained upon the basis of misplaced osteogenetic tissue in the soft tissues, and similarly dispersed through the other involved bones, in characteristic alignment, due to embryologic defective deposition.

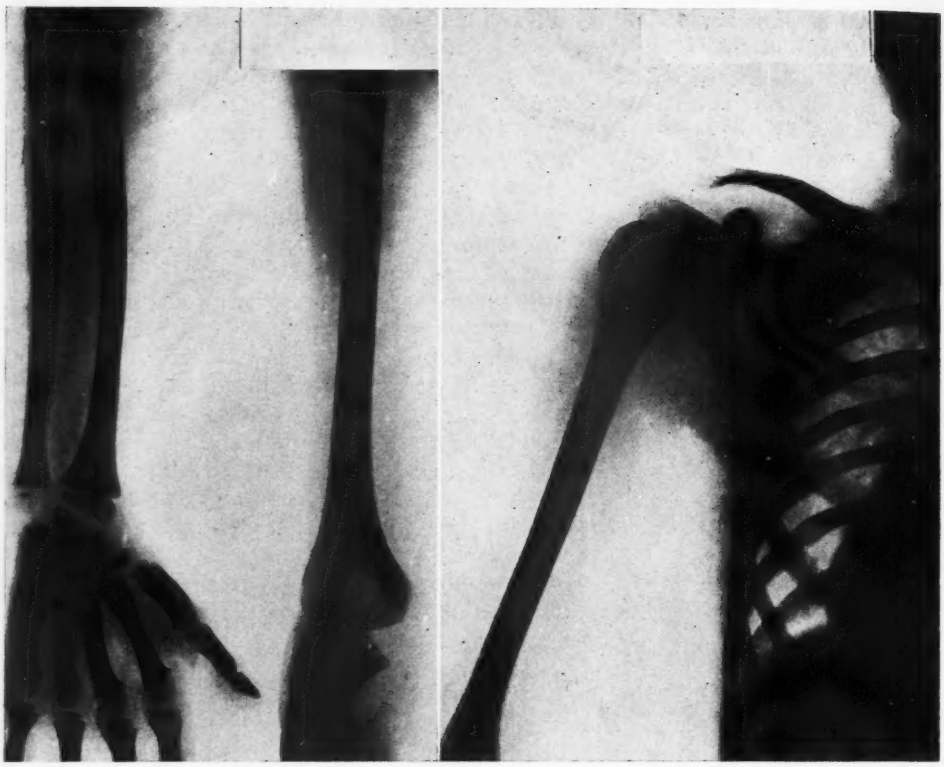


Fig. 2-*B*. Fig. 2-*C*.

Fig. 2-*B*. The flowing hyperostosis is noted to involve the antero-medial aspect of the humerus, sparing of the elbow joint, and reappearing in the radius in its distal one-half. Note the characteristic lack of involvement of the ulna.

Fig. 2-*C*. There are scattered areas of rounded hyperostosis in the scapula, coracoid process, base of the acromion, and superior margin of the glenoid fossa. There are larger scattered areas of osseous condensation in the anterio-medial aspect of the humeral head and proximal metaphysis. The flowing hyperostosis continues along the medial aspect of the humeral diaphysis, mainly endosteal.

HISTOPATHOLOGY

In all the cases reported, only five biopsies were performed and histologic study made. In all of the specimens, there was meager cellular structure, and diminished osteoblastic activity, with the sole exception in the instance of an increase in osteoblasts as mentioned by Leri. In general, the osseous lamellæ presented a density and compactness, resembling overcrowding, together with elongation into bizarre formations at various angles. Junghagen (7) considered a concentric arrangement of the lamellæ about the Haversian canals as a rather characteristic differential diagnostic point. Leri and Roussy (32) made an important contribution, in showing that the heterotopic osseous formations were actually osseous densities containing islands of cartilage.

The majority of observers considered fibrotic replacement of the fat marrow in the medullary canal to be a constant finding, and the vascularity of the tissue to be within limits of normalcy. Putti took exception to the latter observation, thinking that it somewhat resembled a hemangioma. Kauffman (9), in reviewing the section obtained from the patient reported by Zimmer, was unable to report any conclusive features that would be sufficiently characteristic to enable one to make a

diagnosis of any specific disease or entity, such as melorheostosis.

SYMPTOMATOLOGY

Unquestionably, this condition has frequently not been recognized clinically, on account of the minimal subjective symptoms, which are often so slight that medical advice is not sought; and it is conceivable that many patients who have similar complaints are not referred to the radiologic laboratory, but merely treated symptomatically, as "rheumatic." In general, the disease is of insidious onset, and the symptoms become progressively more manifest and increased, but protracted in duration. Occasionally, as was the case reported by the authors, the entity has been recognized by a fortunate coincidental examination to an affected region elsewhere. Very few cases have been diagnosed prior to roentgenographic examination by routine clinical methods, but this probably is due to the unfamiliarity of the clinician with the disease, which is diagnosed as some other pathologic entity.

Considering the recent increased incidence of diagnosis of the process, one is led to believe that it is not as rare as was formerly thought, and it is quite possible that numerous cases have been mis-diagnosed and therapeutic measures instituted without roentgenographic demonstration of the underlying osseous involvement, attention having been focussed upon the soft tissue atrophy. Again, it is quite reasonable to assume that a certain percentage of the cases remain quiescent throughout life, without presenting symptoms or perceptible deformity.

In the light of recent experience, it is imperative that the referring physician request a radiographic consultation on patients complaining of vague, low grade, periodic osteocopic pain, *confined to one extremity*, and not merely treat the case as "rheumatic" or "neuralgic." This is especially important since the symptoms can abate for a period of months or years, with progressive increase in degree of involvement and terminal articular motion impairment. As mentioned, the fugacious character of the pain during the period of growth of the disease accounts for the extensive degree of progressive involvement in the majority of cases reported. Although nothing has been proven to have any influence upon the progress of the affection as yet, it is obvious that such progress can only be made if the case is noted early in its course, and opportunity afforded for the institution of various therapeutic measures, of which radiotherapy looms as the most promising.

The initial symptoms, even though frequently overlooked, occur during childhood, and deformity of the extremity may be observed prior to any symptomatic complaint. The deviation of involved digits should always be considered with suspicion, as this has been a rather common finding. Careful clinical examination should demonstrate definite, albeit slight, shortening of the involved extremity, and soft tissue atrophy. This finding likewise is of great importance, due to its being rather constant.

Limitation of articular movements, unfortunately, is a rather late finding, but this may be the first symptom to cause the patient to seek medical advice. Complete disability due to mechanical impedance of joint motion is rarely found. Bowing of the involved bones, which adds to the shortening already present, is practically limited to the femur, tibia, and fibula, which are weight-bearing sites. The musculature of the extremity becomes atrophic and flabby in most instances, and occasionally circumscribed erythema and nodular induration of the skin overlying the affected bones have been noted. Aside from the local affection, the general health of the patient is usually excellent.

To date, laboratory studies, aside from roentgenography, have added nothing to the diagnosis except in a negative sense, such as eliminating syphilis, hyperparathyroidism, etc. However, routine blood chemistry studies, complement fixation

test, and blood counts should be performed with the endeavor to determine some diagnostic feature.

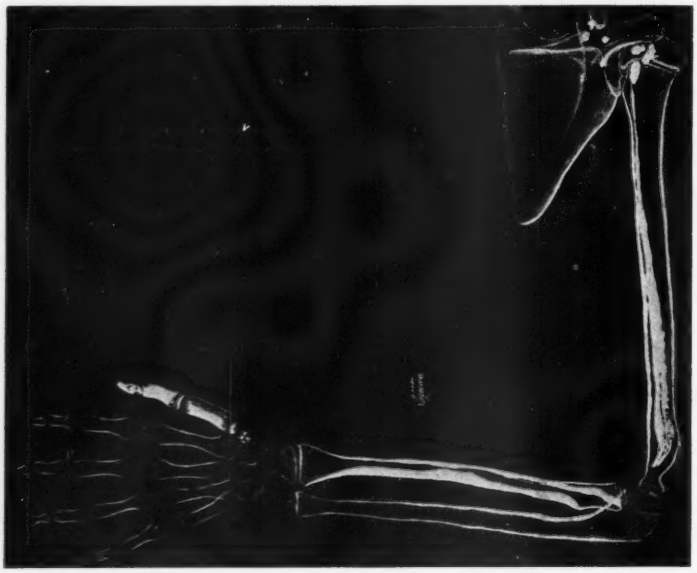


Fig. 3. Composite tracing of the entire left upper extremity, showing the typical rhizomonomelorheostosis.

DIFFERENTIAL DIAGNOSIS

The specific roentgenographic findings and concomitant clinical history described previously are, of course, generally sufficient to formulate a final diagnosis, provided the condition is present in the mind of the examining physician. It cannot be overemphasized that, whenever an osseous lesion is present, particularly a hyperostotic involvement, it is imperative to examine the entire extremity, and even the entire skeletal system. A complement fixation test should always be done, to eliminate the possibility of syphilis, which is probably the most frequent simulant. Tuberculosis might remotely be confusing, as has been reported by Denks (40), but this is always limited to one bone and does not extend from one bone to another. Also, there is calcific deposition in an irregular manner in the medulla primarily, which does not resemble the true bone formation which is encountered in hyperostosis of the endosteal type. Primary osseous neoplasm and secondary metastases of the bones rarely will resemble rhizomonomelorheostosis, and the clinical findings and history will serve to differentiate the same.

The partial continuous and the circumscribed flow types of the process will possibly cause confusion, whereas the complete continuous and interrupted flow groups will present a patent diagnosis, provided, of course, the entire affected extremity has been examined. Ossifying periostitis is difficult to differentiate, but the associated soft tissue atrophy, shortening of the affected part, and selective regional involvement in cases in which duplication of skeletal support exists, will serve as differential points. Calcinosis is usually associated with interstitial soft tissue deposition. Osteitis deformans presents characteristic osteoid tissue formation in trabeculated form. Examination of the skull usually will settle the issue, but even in monostotic Paget's disease, the findings are so different from melorheostosis that no difficulty

should be experienced in this regard. Garré's non-suppurative sclerosing osteomyelitis may be confusing, but in melorheostosis there is hyperostosis on the one aspect of the diaphysis. Osteopoikilosis bears no striking resemblance. Calcified hematoma of the subperiosteal type, and aftermath of scorbutus, can be differentiated by the lack of osseous formation and the history of trauma or other evidence of vitamin deficiency. Myositis ossificans and calcification in hemophilia present very little to simulate rhizomonomelorheostosis.

Blood calcium and phosphorus studies, and urine estimation of calcium, are indicated if hyperparathyroidism is questioned.

Perhaps the most important differential point is the involvement of only derivatives of an anlage of a single extremity, and, accordingly, if osseous lesions exist which are not so demarcated, a presumptive diagnosis of melorheostosis is unwarranted and incorrect.

TREATMENT

Since the causative factors are unknown, it necessarily follows that rational therapy must be lacking. Roentgen therapy has been attempted empirically upon the supposition that subperiosteal telangiectases exist, but no definite regression or growth restraint or amelioration of symptoms has been reported to date. In our own case, we are attempting to determine whether radiation has an effect upon the lesions, by restricting the radiation to one site and employing the remainder of the bone as a control.

CASE REPORT

A. S., male, age 6 years, was referred to the Radiologic Laboratory for examination of the right elbow region for a possible fracture, by Dr. H. L. Dick.

Family History.—Essentially negative, particularly as regarding history of osseous dystrophies, etc.

Personal History.—At the child's birth, both the mother and the attending physician noted a peculiar deviation of the thumb of the left hand. At that time a possible fracture, which might have occurred during delivery, even though the labor was normal and spontaneous, was suspicioned. Unfortunately, roentgenographic examination of the part was not made. The child did not show any signs of disability as he became older, but the mother stated that although the child had never actually complained of this deformity in the past few months she thought that it did interfere somewhat with proper function of the hand. No constitutional diseases aside from measles, were obtained in the anamnesis.

Status Præsens.—The day of the roentgenographic examination the patient had fallen upon the right elbow, and immediately complained of pain, limitation of motion, and marked swelling was noted. Roentgenographic findings revealed the following: a chip fracture of the lateral humeral epicondyle, right side. Routine concomitant examination of the opposite control elbow region disclosed a hyperostotic involvement of the distal end of the humerus and proximal portion of the radius (Fig. 1, p. 661). Melorheostosis was strongly suspicioned and diagnosed, provisionally. Re-examination of the entire skeletal system definitely established the condition to be that of rhizomonomelorheostosis. Inquiries regarding any subjective symptoms of this affected extremity elicited the information that the patient never had as much strength in this extremity as he thought he should have had, but no aches or pains were ever manifest. There was evident restriction in motion of the thumb of the left hand, and the deformity, as described above, the mother stated had been present since birth.

Examination of the patient presented definite, although slight, general shortening and atrophy of the entire left upper extremity, the accurate measurements being as shown on page 628.

Laboratory Findings.—Urinalysis were essentially normal. Complete blood count and differential were within normal limits. Both the Wassermann and Kahn determi-

nations were repeatedly negative. No clinical signs or symptoms were manifest, to suggest an endocrine dysfunction or altered basal metabolism. No blood smears were taken for possible malarial parasites, and no signs were suggestive of the same. Blood calcium = 10.0 mg. per cent; blood phosphorus = 5.3 mg. per cent; blood urea N = 12.0 mg. per cent; blood sugar = 78.0 mg. per cent, all values of which are essentially normal.

Roentgenographic Findings.—As shown in Figures 2-*A*, 2-*B*, 2-*C*, and 3, the involvement of the entire left upper extremity conformed to the designated complete continuous flow variety of rhizomonomelorheostosis. There was hyperostosis with predominance of the endosteal type except in the first digit, where there was more periostosis manifest than the associated endosteosis. Occasional areas of rounded hyperostosis were noted in the left scapula, coracoid process, base of acromion, and the superior margin of the glenoid fossa. Similar, but larger, scattered areas of osteoblastic condensation were situated in the anterior and medial aspects of the left humeral head and proximal metaphyseal regions. Commencing at the proximal portion of the humeral diaphysis, and medial aspect thereof, there was a rather characteristic hyperostotic flow, of the endosteal type, becoming gradually more extensive in its distalward progress, and confined to the antero-medial portion of the humerus. This process became attenuated in the very distalmost portion of the inferior humeral metaphyseal site, then completely spared the articulation of humerus and forearm. The radius was involved to a rather marked degree, from its neck region to the distal metaphysis, confined mainly along the ulnar aspect and to a much less extent along the proximal portion of the lateral aspect of the radius. The carpal articulation, again, was uninvolved. There was curious condensation in the greater multangular, which resembled a condensing ostosis. The entire first digit was markedly involved, inclusive of the metacarpal epiphysis, ulnar aspect of the metacarpal, epiphysis of the proximal phalanx, practically the entire proximal phalangeal shaft, the epiphysis and body of the distal phalanx, with predominating periostotic development. There was gross deviation of the fist digit, as described heretofore. The remainder of the entire skeletal system presented no abnormal osseous findings, being of average normal description.

The patient's younger brother, aged 4 years, was similarly examined, and the roentgenographic appearances of the entire torso was found to be average. Roentgenologic examination of the parents disclosed no analogous or other osseous pathologic changes.

Due to the lack of symptomatic complaints of any degree by the patient, it was difficult to convince the parents of the advisability of instituting a therapeutic test of irradiation, employing one-half of the involved area as a control. Permission for this experiment has now been granted us by the parents, and is being conducted.

ROENTGENOGRAPHIC MENSURATION

	Left (affected)		Right (normal)	
Humerus	$8^{5}/_{8}$ inches	21.8 cm.	$8^{3}/_{4}$ inches	22.2 cm.
Radius	6 "	15.2 "	$6^{1}/_{2}$ "	16.5 "
Ulna	$6^{1}/_{2}$ "	16.5 "	7 "	17.7 "
1st digit	$2^{7}/_{16}$ "	6.1 "	$2^{12}/_{16}$ "	5.3 "
2nd digit	$3^{15}/_{16}$ "	9.9 "	$4^{1}/_{16}$ "	10.3 "
3d digit	$4^{3}/_{16}$ "	10.6 "	$4^{4}/_{16}$ "	10.7 "
4th digit	$3^{15}/_{16}$ "	9.9 "	$3^{14}/_{16}$ "	9.8 "
5th digit	$3^{5}/_{16}$ "	8.4 "	$3^{7}/_{16}$ "	8.7 "
Measurements of the Circumference of Arm and Forearm				
Arm	$7^{1}/_{2}$ inches	17.5 cm.	$8^{1}/_{4}$ inches	21.5 cm.
Forearm	$5^{1}/_{2}$ "	13.8 "	6 "	15.0 "

If this is an early stage of rhizomonomelorheostosis, which we consider it to be, and by radiotherapeutic measures the process can be made quiescent and stationary, this will obviously be an important observation, not only relevant to curative effect, but as to the etiology of the process, particularly as regards the osteal telangiectatic theory. We are endeavoring to examine this affected extremity at definite intervals, to ascertain whether the entity, *i.e.*, the non-irradiated portion, can evolve into different types, during the growth period.

SUMMARY

1. Rhizomonomelorheostosis is a flowing hyperostosis involving the derivatives of an anlage of a single extremity and pathognomonically the remainder of the skeleton is unaffected.

2. Including the authors' report, 23 cases have been described in the literature, and three cases not as yet published have been observed in the United States.

3. The evidence at hand would lend most support to the embryonic metameric disturbance theory, propounded by Zimmer.

4. The classification of Kraft, relegating the lesions into the following types: complete continuous flow; partial continuous flow; interrupted flow, and circumscribed flow, is excellent only in regard to anatomical involvement, and there is nothing to substantiate the inference that the duration and degree of pathologic involvement are related to these types. The hyperostosis is of the endosteal or periosteal type, or both.

5. The histopathology does not present specific features, but in general there was a rather constant finding of fibrotic replacement of the fat marrow in the medullary canal. There is a divergence of opinion as to the significance of concomitant vascular proliferation.

6. The symptoms are occasionally entirely absent, but usually rheumatic, low grade osteocopic pain, confined to one extremity, and some degree of loss of strength in the affected extremity are present. Later, limitation of articular movements, pseudo-ankylosis, and bowing of the involved bones, particularly, if weight-bearing function is maintained. The peculiar deviation of the involved digits is so frequently observed in this disease that this finding alone should cause one to suspect the disease, and to demand roentgenographic examination. Absolute soft tissue and osseous atrophy is almost constantly definable.

7. The diagnosis to date has been made only by roentgenographic examination, and a differential diagnosis from other osseous pathologic lesions is rarely difficult.

8. Laboratory studies should always be performed, but add no positive information.

9. No therapy to date has been of avail, but roentgentherapy has been instituted, and results therefrom will be forthcoming.

BIBLIOGRAPHY

(1) Bromer, R. S., and John, R. L.: Olliers' Disease. Unilateral Chondrodysplasia. Am. Jour. Roentgenol. and Rad. Ther., September, 1931, **26,** 428–435.

(2) Comby, J.: La melorheostose. Arch. de Med. d. Enf., 1928, **31,** 741–749.

(3) Froelich, Nancy: Quatre cas de tibias eburnes. (Osteose eburnante de Putti ou os marmoreen de Allemands.) Rev. d'orthop., 1929, **16,** 1–31.

(4) Geschickter, C. F.: The Roentgenologic Diagnosis of Bone Tumors. Radiology, 1931, **16,** 11–180 (p. 155).

(5) Geschickter, C. F., and Copeland, M. M.: Tumors of Bone. Am. Jour. Cancer, 1931.

(6) Goldschlag, F.: Ueber eine Kombination von Trophödem Meige mit Melorheostose Leri. Dermat. Wochnschr., 1929, **89,** 1761–1766.

(7) Junghagen, S.: Sur la melorheostose. Jour. de radiol. et d'electrol., 1930, **14,** 495–500.

(8) Kahlstorf, A.: Zur Kenntnis der melorheostose (Leri) und generalisierten Ostitis condensans oder Osteopoikilie (Albers-Schönberg). Röntgenpraxis, 1930, **2,** 721–732.

(9) Kauffman: Demonstration von Röntgenbildern und histologischen Präparaten eines Falles von Melorheostose. Zentralbl. f. klin. Chir., 1929, **56,** 1631.

(10) Kemkes, H.: Ueber ein Fall seltener Erkrankung der Knochen einer Extremität. Arch. f. klin. Chir., 1929, **156,** 268–273.

(11) Kraft, E.: Melorheostosis Leri: A Flowing Hyperostosis of a Single Extremity. Jour. Am. Med. Assn., 1932, **98,** 705–709.

(12) Idem: The Pathology of Monomelic Flowing Hyperostosis. Radiology, January, 1933, **20,** 47–55.

(13) Lazzarini, L.: La meloreostosi. Gazz. d. osp., 1928, **49,** 1405–1407.

(14) LERI, A., and JOANNY: Une affection non decrite des os: Hyperostose "en coulée" sur tout la lomgeur d'un membre ou "melorheostose." Bull. et mém. Soc. med. d. hôp. de Paris, 1922, **46,** 1141–1145.

(15) LERI, A., and LIEVRE, J. A.: Sur une maladie nouvelle des os: l'hyperostose d'un membre "en coulée" ou "melorheostose." Bull. Acad. de Méd., Paris, 1928, **99,** 737–739.

(16) IDEM: La melorheostose (hyperostose d'un membre "en coulée"). Presse med., 1928, **36,** 801–805.

(17) IDEM: Una malattio dello scheletro recentement descritta: la meloreostosi. Rassegna internaz. di clin. et terap., 1928, **9,** 621–627.

(18) LERI, A., LOISELEUR, and LIEVRE, J. A.: Une nouvelle observation de melorheostose. Bull. et mém. Soc. med. d. hôp. de Paris, 1930, **54,** 1210–1217.

(19) LEWIN, P., and MACLEOD, S. B.: Osteosclerosis with Distribution Suggesting that of the Ulnar Nerve: An Unclassified Bone Condition. Jour. Bone and Joint Surg., 1925, **7,** 969–981.

(20) MEDA, G.: Sulle osteopatie fibrose e deformanti con particolare riguardo al morbo di Paget. Radiol. med., 1927, **14,** 885–917.

(21) MEISELS: La melorheostose. Bull. et mém. Soc. de Radiol. med. de France, 1928, **16,** 241–244.

(22) IDEM: Nouvelle observation de melorheostose. Presse med., 1928, **36,** 1466.

(23) IDEM: Une nouvelle observation de melorheostose. Bull. et mém. Soc. med. d. hôp. de Paris, 1928, **52,** 1531–1534.

(24) IDEM: Das Krankheitsbild der Lerischen Melorheostose. Röntgenpraxis, 1929, **1,** 680–689.

(25) MOORE, J. J., and DE LORIMIER, A. A.: Melorheostosis Leri. Am. Jour. Roentgenol. and Rad. Ther., February, 1933, **24,** 161–171.

(26) MILANI, E.: Su di un caso di osteosi eburneizzante monomelica. Arch. di. radiol., 1930, **6,** 70–74.

(27) MUZII, M.: Iconografia rara di malattie delle ossa. Radiol. med., 1926, **13,** 435–438.

(28) PIERGROSSI, A.: Su di un caso di osteosi eburneizzante monomelica (melorheostosi). Arch. di radiol., 1931, **7,** 20–50.

(29) PUTTI, V.: L'osteosi eburniezzante monomelica. (Una nuova sindrome osteopatica.) Chir. d. org. di movimento, 1927, **2,** 335–361.

(30) RENDU, A., and GAY, P.: Un cas de femur eburne. Rev. d'orthop., 1929, **16,** 639–643.

(31) ROKHLIN, D. G.: Melorheostosis. Vestnik. röntgen i. radiol., 1931, **9,** 292–296.

(32) ROUSSY: Cited by Leri and Lievre.

(33) SAUPE: Beitrag zur melorheostose. Klin. Wchnschr., July, 1932, **2,** 1183–1186.

(34) SICARD, GALLY, and HAUGENAU: Osteites condensantes a etiologie inconnue. Jour. de radiol. et d'electrol., 1926, **10,** 503–507.

(35) SCHOR and HEINISMANN: Melorheostosis. Fortschr. a. d. Geb. d. Röntgenstrahlen, October, 1933, **48,** 440.

(36) VALENTIN, B.: Ueber einen Fahl von Melorheostose. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1928, **37,** 884–889.

(37) IDEM: Klinische Demonstration. Fortschr. a. d. Geb. d. Röntgenstrahlen, April, 1928, **37,** 571.

(38) WEIL, M. P., and WEISSMAN-NETTER, R.: Un cas de rheosteose (melorheosteose de André Leri et Joanny). Gaz. med. de France, January 15, 1932, pp. 50–52.

(39) ZIMMER, P.: Ueber ein Fall einer eigenartigen seltenen Knochenerkrankung, osteopathy hyperostotica. Melorheostose. Beitr. z. klin. Chir., 1927, **140,** 75–85.

(40) DENKS, H.: Shaft Tuberculosis and Enostosis. Fortschr. a. d. Geb. d. Röntgenstrahlen, November, 1933, **48,** 584.

CARMAN NIGHT[1]

PRESIDENT W. HERBERT MCGUFFIN, M.D.: *Ladies and Gentlemen:* We meet here to-night to do honor to the memory of our former confrère and to one of the most outstanding roentgenologists of the first quarter of the present century—a man born a Canadian, naturalized an American and, passing away, recognized by his life's contribution as a world's citizen. I refer to the late lamented Dr. Russell D. Carman, who was one of the foremost figures in American medicine.

It has been the custom for us to create a myth concerning our distinguished men who have lived and passed on. Later we have gone through the process of brutally debunking them. We may save ourselves such bitterness if we try to see Carman as he was in his true perspective.

As chief of the roentgen services of the Mayo Foundation, handling thousands of cases every month with the most satisfying results, he will be remembered for his untiring attention and skill. Only a man of deep and simple devotion who proclaimed, "My work is my hobby," could have accomplished so much.

As a contributor to radiology he was second to none, and there are branches of our specialty to which he made special contributions that will always be associated with his name.

He was honored by his fellows who elected him to the highest posts in the various medical organizations of which he was a member. He did honor to them all and has left behind him a tradition it will be difficult to emulate. His work will be a lasting memorial to his greatness of skill and character, and whilst we grieve at what seemed to us his untimely passing, cut off as he was at the early age of fifty-one, we rejoice to-day for the gifts he spent so freely in the interest of suffering humanity.

But to-night I think of him as Carman, the man. Those of you who have ever had the big arms of Russell D. Carman encircling your shoulders will know something of the thrill which comes to one as we recall his name. It was a rare privilege to meet him and an inspiration to know him, and the warmth of his fellowship infected all those who came into contact with him. He was never too occupied or engrossed to lose touch with his fellow-man, and his sympathy and understanding endeared him to all who knew him.

For that fine humanity it will always be said of him that "to live in the hearts of those we leave behind is never to die."

The keynotes of his character appeared to me to be his courage and discipline—courage in facing every situation and never knowing defeat, and the discipline of his life that gave all he had to the goal he kept before him.

Notwithstanding the fact that the American Roentgen Ray Society has placed a tablet to his memory at the Mayo Clinic and that the Minnesota Radiological Society has inaugurated a "Russell Carman Memorial Lecture," your President has felt that in view of the important part that Russell Carman played in the life history of our Society that we, too, should be privileged to offer tribute to him.

To this end we have instituted the "Carman Lecture," hoping that we shall make it an annual or bi-annual feature of our program.

In honoring the memory of Dr. Russell D. Carman by establishing the Carman Lecture, it is my privilege to introduce to you Dr. B. R. Kirklin. Much thought and time were given by the Mayo Clinic to the possible successor to Dr. Carman, and in the appointment of Dr. Kirklin to take his place it does seem as if the mantle of Elijah has fallen upon Elisha, and we wish to offer to Dr. Kirklin our congratulations for the perpetuation of that fine tradition which his predecessor established.

---

[1] Proceedings of Twentieth Annual Meeting of the Radiological Society of North America, at Memphis, Tenn., Dec. 3–7, 1934.

We are also happy to-night in having with us Dr. Donald C. Balfour, who will address us on the subject of "The Debt of Surgery to Roentgenology." The time is not so remote when we heard cutting remarks on this subject, but it augurs well for our future when such a well-known man as Dr. Balfour, so distinguished in his special field of surgery, comes to us, and we welcome him with attention and respect. Dr. Balfour was also closely associated with Dr. Carman for many years and I understand that he will give us some appreciation of his work and life.

Dr. Balfour happens to be a Canadian. I sincerely hope that you will not think we are trying to put Canada forward; there are no boundaries in science.

SOME PHASES OF THE ROENTGENOLOGIC DIAGNOSIS OF GASTRIC CANCER

CARMAN LECTURE

By B. R. KIRKLIN, M.D., *Rochester, Minnesota*
Section on Roentgenology, The Mayo Clinic

THE great radiologist whom we commemorate this evening was profoundly interested in the diagnosis of gastric cancer. He made substantial contributions to the science and art of its diagnosis. His criteria for the radiologic identification of gastric cancer, as set forth in his book, are widely followed to-day. He was a victim of the disease and himself made the diagnosis under dramatic circumstances. For these reasons I have deemed the topic appropriate for this occasion.

Although the radiology of the alimentary canal actually began in America with Bowditch's suggestion to Cannon, which resulted in the latter's notable researches on animals, and with the examination of a child's stomach by Williams and Cannon, the capabilities of the new method were not appreciated in this country and the next steps in advance were made by Europeans, but only after many years. When Carman came to Rochester, in 1913, he knew relatively little about gastro-intestinal radiology. When he walked out of the screen room for the last time, now nine years ago, he was undoubtedly one of the ablest radiologic diagnosticians of gastric and duodenal disease in the world. How did he acquire this knowledge and skill?

The late Russell D. Carman, M.D., in whose honor the yearly Carman Lecture has been instituted.

Not by sparkling brilliance of mind or effortless inspiration, but by hard work, well applied.

Carman's mental processes were simple, direct, almost invariably accurate, and, above all, thorough. He thought his problems through. From the older radiologists Carman received less of instruction than of stimulation. He respected their dicta, but never accepted them fully until he had

[1] Read before the Radiological Society of North America, Memphis, Tenn., Dec. 3 to 7, 1934.

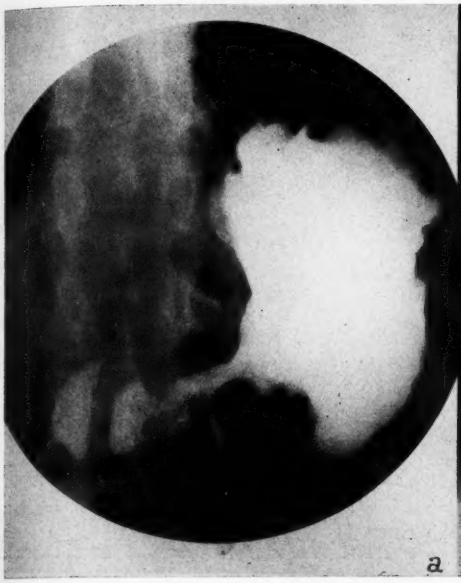


Fig. 1-*A*. Extensive ulcerating medullary carcinoma of the distal half of the stomach.

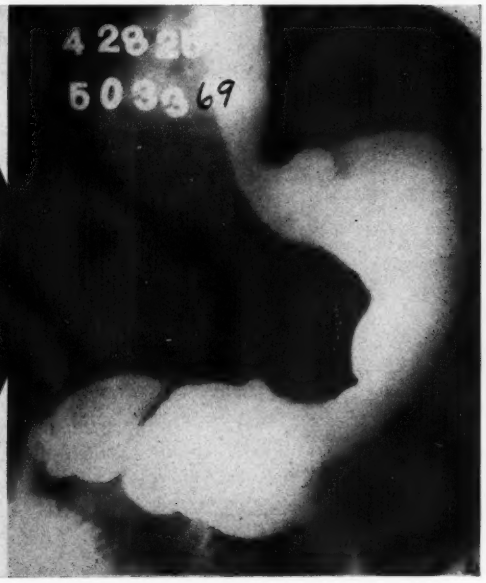


Fig. 1-*B*. Extensive scirrhous carcinoma of the proximal three-fourths of the stomach.

proved them by personal observation. So, at the Mayo Clinic, Carman consistently followed his cases to the operating room, the necropsy table, or the pathologic laboratory. Thus all that Carman knew, which was much, he learned at first hand and knew beyond all shadow of doubt. He knew the morbid anatomy of gastroduodenal disease in relation to its radiologic manifestations as few other men have ever known it. His mental picture of gastric cancer, for example, was not derived merely from drawings, or from photographs or lantern slides, but from its varied radiologic images, its appearance when the abdomen was opened, its gross aspects after removal, and its histologic structure as revealed by the microscope, all of which he synthesized into a coherent and practical conception of the disease. Thus Carman not only taught by trustworthy precept but set an example which may well be followed by all radiologic diagnosticians.

MORBID ANATOMY

Every radiologist knows, but he sometimes fails to realize thoroughly, that cancer may take the form of a frank tumor, an infiltration, or an ulcer without evident tumefaction. He is aware, too, that not all cancers are extensive when discovered, and that often they are demonstrable when exceedingly small. He knows, further, that although cancer has a preference for certain segments of the stomach, it may affect any part of the viscus. But circumstances impel him to keep much of this knowledge in latent form, and to think idly of cancer as a massive tumor, typical in situation and deforming the barium shadow so grossly and so characteristically that the disease can scarcely escape recognition. It is true, unfortunately, that most cancers are well advanced when their presence is first determined and that, as cancer is essentially a neoplasm, hyperplasia with production of a tumor is a primary trait. But it is to be remembered that cancer is also marked by ulceration, and this feature is scarcely less common than that of tumefaction. Occasionally ulceration is so dominant that tumefaction cannot be discerned with the unaided eye, even on close scrutiny of the excised specimen, and mor-

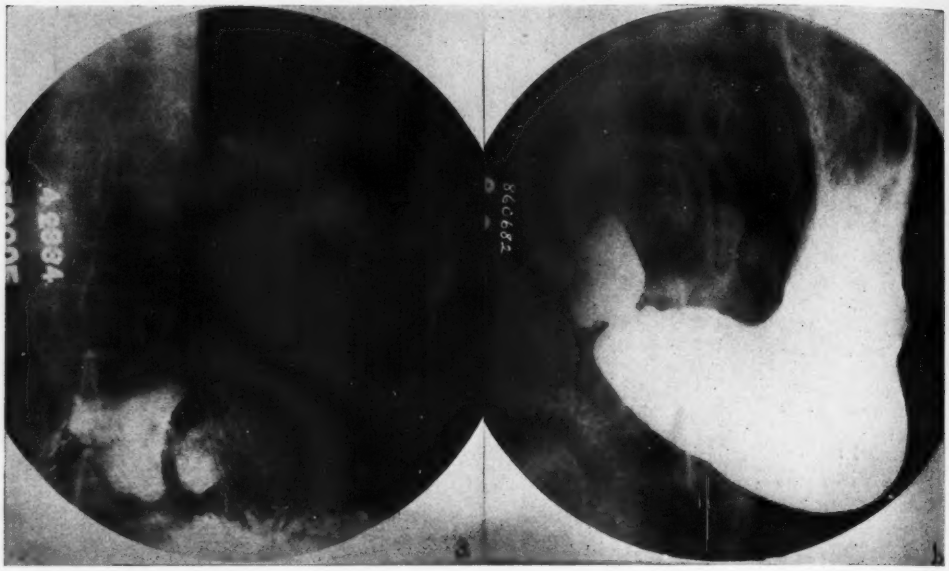


Fig. 2-*A*. Internal relief of extensive scirrhous carcinoma.

Fig. 2-*B*. Early scirrhous carcinoma of the cardia

phologically the lesion must be rated an ulcer. Thus the examiner is obliged constantly to remind himself that cancers range with intermediate gradations from tumors to ulcers and, therefore, may imitate any of the benign lesions. He may also need to stimulate his recollection that the histologic variety and situation of a malignant newgrowth materially affect the radiologic syndrome and the readiness with which the disease can be disclosed and identified. Finally, he will have to resist any tendency to assume that because a lesion is small it is probably not malignant.

TECHNIC

To elicit these morbid anatomic changes, the radiologic examination must be methodical and thorough. It should be radioscopic in order to permit observation at many angles and to carry out the manipulations that are indispensable. Care should be taken to make sure that the patient's stomach is empty; evacuation beforehand with the tube is always desirable and sometimes necessary. It is important that the patient's abdomen be relaxed completely, so that palpatory investigation may be fruitful. Most important of all is an adequate portrayal of the mucosal relief. Accordingly, at the beginning of the examination the patient should take but one or two swallows of the barium suspension, which should be distributed over the mucosa by manipulation, and the stomach should not be filled until the internal relief has been inspected attentively. The principle of this technical detail can be traced back to Forssell's notable researches on the mucosal folds, and it was applied early by Holzknecht, who realized the significance of certain changes in the internal topography that are demonstrable only in the face view. The latter's followers, among whom was Carman, have habitually included inspection of the rugal pattern in their radioscopic routine. Notwithstanding these facts the potential import of the mucosal relief was not generally comprehended until Akerlund and Berg forcefully called attention to it, introduced technical refinements, and presented the results of their intensive studies. In so doing they have made a substantial contribution to radiology.

Fig. 3-*A*. Large phytobezoar (persimmon ball) in stomach.

Fig. 3-*B*. Phytobezoar shown in Figure 3-*A*.

Fig. 3-*C*. Pressure defect, upper third of stomach, caused by an enlarged spleen; the mucosal relief is normal.

ADVANCED CANCER

Advanced medullary cancer commonly presents a picture that is almost pathognomonic. The mass projects from a wide base far into the lumen and is represented by a gross defect in the barium shadow. As a rule, the tumor has multiple ulcerous excavations, which appear as pseudo-niches or striking irregularities of its surface or profile (Fig. 1-*A*). The involved portion of the gastric wall is sharply demarcated from the uninvolved portion. The general form of the stomach is likely to be preserved and its capacity diminished only in proportion to the size of the intruding mass. Advanced scirrhous cancer gives rise to a picture that is even more typical (Fig. 1-*B*). With its preference for the pyloric segment and its tendency to encircle the stomach, the infiltrative growth is likely to convert the distal half of the stomach into a funnel, or, if the invasion is more extensive, the barium shadow often takes the shape of a leg of mutton. Ulceration is widespread and occasionally deep in some places, but most of the ulcers are shallow, and the internal aspect of the tumor is smoother than that of medullary cancer. Often the internal relief has a granular appearance, and the shadow is somewhat like that of ground glass (Figs. 2-*A* and 2-*B*). I consider this to be an important and rather distinctive mark of scirrhous cancer. Diminution of the capacity of the stomach is a notable feature, and this results not so much from the intrusion of the tumor, as from shrinking, shortening, and loss of expansibility of the affected segment.

Common to both forms are certain physical signs and secondary phenomena. When the disease affects the antral or middle segments of the stomach, both of which are usually accessible to palpation, a mass corresponding to the visible defect or deformity can be felt unless the neoplasm is exceedingly small. Palpability of a gastric tumor is always strongly suggestive of malignancy. Occasionally in scirrhous cancer a mass cannot be felt definitely, but the affected segment is stiffened and slips away under finger pressure. By extension of the cancer to contiguous structures or by the production of adhesions, the stomach may become fixed or less than normally mo-

Fig. 4-*A*. Benign angioma in middle third of stomach.

Fig. 4-*B*. Gross specimen.

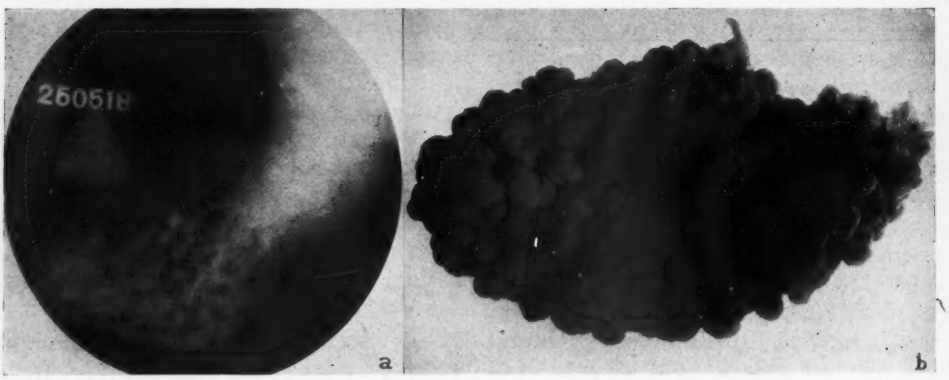


Fig. 5-*A*. Polyposis (polyadenomes en nappe) of distal half of stomach.

Fig. 5-*B*. Resected specimen.

bile, and the loss of mobility is determinable by manipulation. With rare exceptions peristalsis is absent in the region of the affected segment, and such absence is of confirmatory and differential value. Moderately obstructive cancer of the prepyloric segment may give rise to hyperperistalsis or antiperistalsis of the uninvaded portion of the stomach, but either manifestation is uncommon. Ordinarily in nonobstructive cancer, peristalsis of unaffected portions of the gastric wall is less marked than in normal stomachs. Almost without exception gastric motility is notably altered. In the absence of obstruction the pylorus commonly is gaping, the barium suspension flows through it almost continuously, and the stomach is evacuated in much less than normal time. This hypermotility is sometimes attributable in part to stiffening of the pyloric muscle by infiltration, but the concomitant achylia is

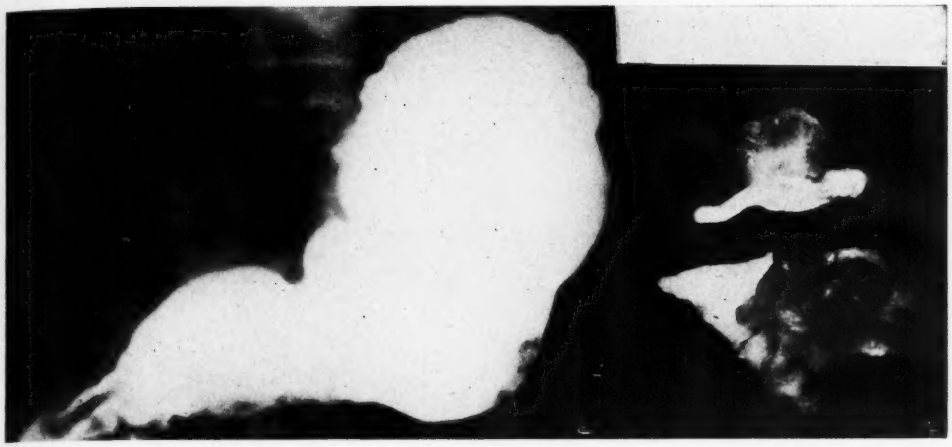


Fig. 6-*A*. Two small polyps on posterior wall, near greater curvature, at juncture of upper and middle thirds of stomach. Fig. 6-*B*. The polyps, which on microscopic examination proved to be adenocarcinomas of low grade.

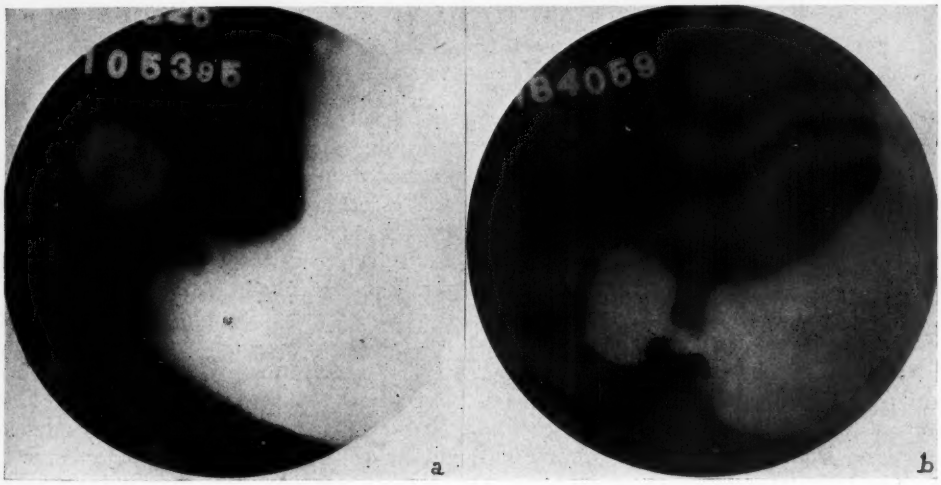


Fig. 7-*A*. Small annular prepyloric carcinoma.

Fig. 7-*B*. Prepyloric ulcer with spastic deformity; the niche of the ulcer is not shown.

doubtless the principal causative factor. Obstruction occurs in from 50 to 60 per cent of cases and is evidenced by a residue from the six-hour meal or by scant evacuation during the examination.

DIFFERENTIAL DIAGNOSIS OF ADVANCED CANCER

The first task of the examiner is to determine that the shadow defects, deformities, and secondary manifestations observed are really due to gastric disease and not to other causes. Among such causes are food or foreign bodies in the stomach, pressure by the spine, ascites, gas or fecal material in the colon, strong retraction of the abdominal wall, extrinsic tumors, and spasm. The simulants are so well known and have been described so often that few of them need to be discussed here.

The bezoars—balls of hair, persimmon seeds, and so forth—have striking features that are practically diagnostic (Fig. 3-*A*). They produce a central reticulated or mottled defect, are often displaceable in the stomach, and the contour of the stomach is not altered. But because a bezoar sometimes gives rise to a large ulcer and a definite mass can usually be felt, the examiner is likely to confound it with ulcerating cancer.

Tumors of structures adjacent to the stomach deform the gastric lumen by pressure, and as they are usually palpable, may readily be mistaken for cancer. However, as a rule, an extrinsic tumor can be separated from the stomach by manipulation, and the rugæ are not effaced in the area of deformity (Fig. 3-*B*).

As for reflex gastrospasm, the test by administering tincture of belladonna to full physiologic effect, as recommended by Carman, is still often applied at the Clinic in suspected cases. It is probable that much that is called spasm is really caused by rigidity and retraction of the abdominal wall or by the patient's apprehension and agitation, and that reflex spasm from nongastric disease is likely to disappear even when belladonna is not given, but it is safer to employ this test.

In contrast with all simulants of disease, the shadow-deformity produced by cancer is persistent as to site and configuration, obliterates the rugal markings, is not altered by manipulation, withstands antispasmodics, and remains unchanged at reexamination.

When it is certain that a lesion is present, cancer may require distinction from benign newgrowths, gastric syphilis, diaphragmatic hernia, or sarcoma.

In most cases the benign neoplasms are relatively small, pedunculated, and multiple but not numerous. They usually produce ovoid, central shadow-defects, can often be shifted to some extent by manipulation, rarely alter the general contour of the stomach, are not often palpable, and seldom inhibit peristaltic contraction at their sites of attachment (Figs. 4-*A* and 4-*B*). Similar considerations apply to extensive polyposis, particularly the *adenomes en nappe* of Menetrier (Figs. 5-*A* and 5-*B*). Although Carman had previously seen only one instance of polyposis, he quickly recognized the first case that he saw after he came to the Clinic (Fig. 5-*A*). His associates recall his remark that, on palpation, the stomach "felt like a bag filled with worms" (Fig. 5-*B*). But while benign neoplasms of the stomach usually can be dis-

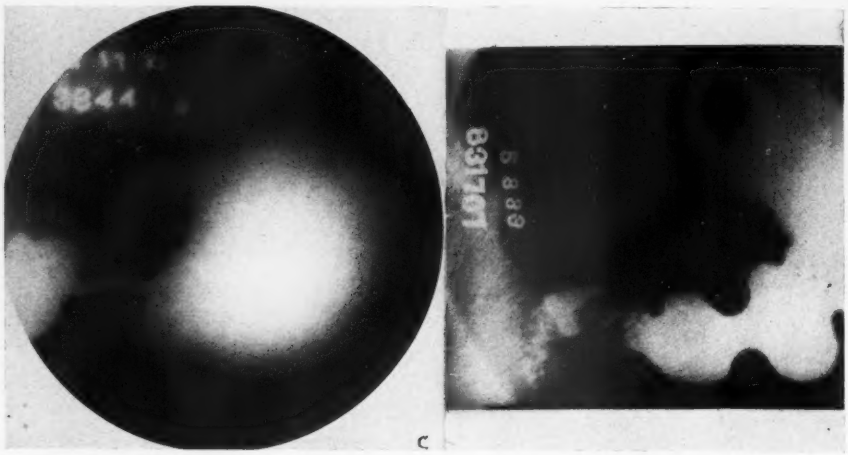


Fig. 7-*C*. Syphilis affecting the prepyloric segment. Fig. 7-*D*. Hypertrophy of the pyloric muscle.

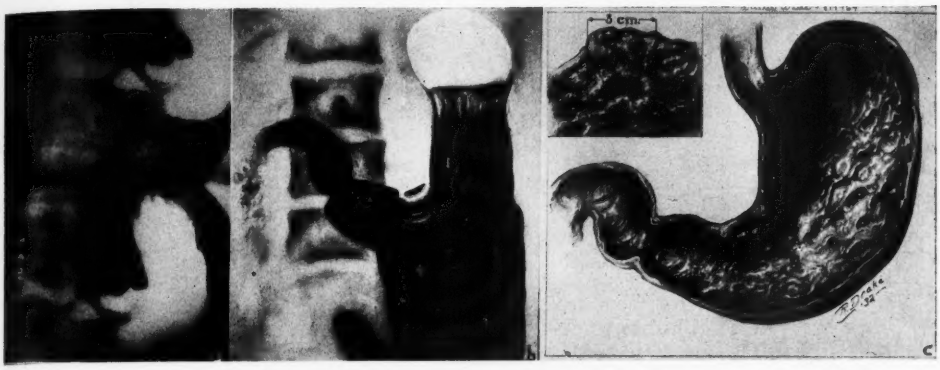


Fig. 8-*A* (*left*). Ulcerating carcinoma on the lesser curvature which illustrates the meniscus sign-complex. Fig. 8-*B* (*middle*). Roentgenoscopic demonstration of a small ulcerating carcinoma on the lesser curvature, with the typical meniscus sign-complex. Fig. 8-*C* (*right*). The carcinoma shown in Figure 8-*B*.

tinguished from those which are cancerous, the radiologist should not put too fine a point on this distinction, for newgrowths that appear to have been benign primarily are often found to have cancerous areas indicative of malignant change, and many of the polypoid growths of the alimentary canal seem to be particularly susceptible to such change.

It is difficult to evaluate the extent of consideration that should be given to gastric syphilis in the differential diagnosis of cancer. That gastric syphilis occurs cannot be doubted, but its incidence is perhaps more often exaggerated than minimized. At the Clinic less than a hundred cases of what was believed to be gastric syphilis have been encountered. In most of these, the diagnosis rested on clinical, serologic, and radiologic data, together with the effect of anti-syphilitic therapy, and in only a minority of instances was the evidence fortified by microscopic examination of tissue excised from the lesion. From this series of cases it appeared that syphilis of the pyloric or median segment of the stomach may cause deformity imitating that produced by scirrhous cancer, and that more extensive syphilis may closely resemble the variety of scirrhous cancer that is often called fibromatosis. Syphilis rarely, if ever, produces a definitely palpable tumor, and this feature in conjunction with clinical findings, such as the fact that the patient is below the cancer age or is not ill in proportion to the extent of the gastric lesion, is usually the basis for a provisional diagnosis of syphilis, subject to further investigation.

Hernia of the stomach through the diaphragm, usually of the cardia through a breach in the left arch of the diaphragm or through the esophageal hiatus, is often mistaken for cancer. In both affections the cardiac segment is grossly distorted, and the esophagus is more or less obstructed. However, in hernia the cardiac dome is demonstrably above the line of the diaphragmatic arch and the upper level of the opaque meal is above that of the esophageal aperture, whereas, in cancer, the dome is below the arch and the level of the opaque meal coincides with that of the esophageal opening. Often a gastric ulcer occurs at the point of constriction and may give rise to an inflammatory mass, so that the examiner is likely to suspect that the hernia is associated with cancer.

Sarcoma of the stomach, which is most often lymphosarcoma or other variety of lymphoblastoma, is a rare affection. It has no definite radiologic marks of distinction from cancer, but the examiner may surmise the existence of the condition from the youth of the patient, and general lympha-

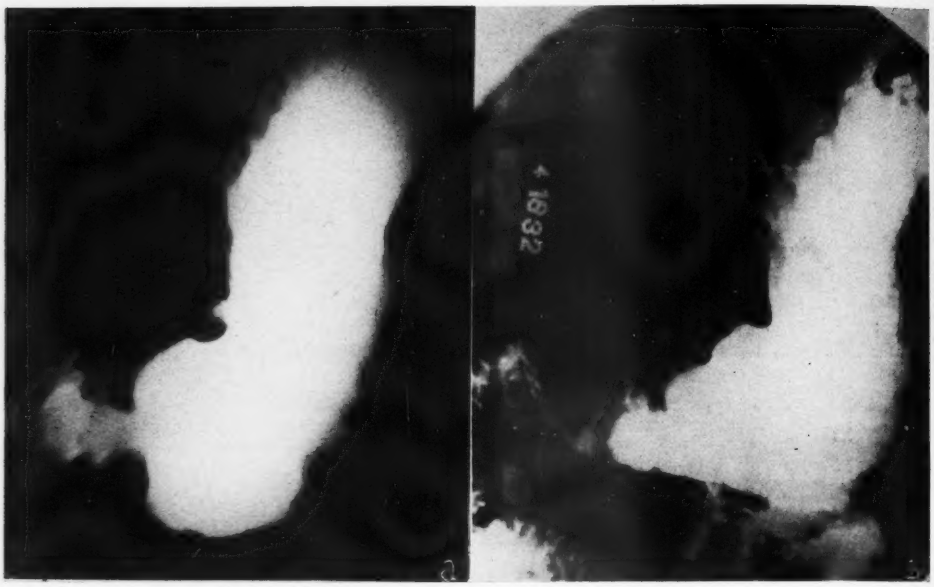


Fig. 9-*A*. Perforating ulcer on lesser curvature just above the angle.

Fig. 9-B. The niche of the ulcer has disappeared after three weeks' intensive treatment.

denopathy or involvement of the mediastinal lymph nodes.

On the whole, distinction of advanced cancer from other diseases or the simulants of diseases is not often difficult, provided the examiner is alert in observation and logical in judgment. Small and presumably early cancers are less easy to discern and identify.

EARLY CANCER

Four varieties of early cancer may be considered: (1) small malignant tumors or infiltration without deep ulceration; (2) early prepyloric cancers; (3) small ulcerating cancers, and (4) malignant ulcers.

Small pedunculated medullary cancers without marked ulceration are encountered occasionally. Because they are relatively small and are so often pedunculated they are likely to be mistaken for benign growths (Figs. 6-*A* and 6-*B*).

Early infiltrating, scirrhous cancer of limited extent is exceedingly hard to disclose, for it seldom produces an obvious marginal defect. Even moderately advanced scirrhous cancer, when confined to the lesser curvature, is likely to be deceptive, and the unwary examiner may overlook it completely. On casual observation the general form of the stomach appears to be normal, the lesser curvature seems to be smooth, and the lumen is not noticeably narrowed, or, if slight narrowing is evident, it resembles that produced by pressure from an enlarged liver or extragastric tumor. On closer inspection it will be seen, however, that the curvature is abnormally smooth, peristalsis is likely to be absent, and consequently the normal angular incisure is lacking. Localized absence of peristaltic indentations is generally regarded as strongly indicative of a stiffening lesion in that region, but, even though rarely, peristalsis may occur in a cancerous gastric wall. In my opinion, a more convincing and reliable sign of early scirrhous cancer is the granular internal relief which it produces (Figs. 2-*A* and 2-*B*).

Early cancer of any variety in the cardia may elude discovery unless this region is inspected carefully. Retarded flow of barium from the esophagus, division of the

Fig. 10-*A*. Perforating ulcer on lesser curvature at the angle with the roentgenologic features of malignancy.

Fig. 10-*B*. After three weeks' treatment. The ulcerating lesion has increased markedly and signs of malignancy are more pronounced. At operation, an adenocarcinomatous ulcer of Grade 4 was found.

barium stream by a small tumor, and deformity of the normally smooth and symmetrical gas-bubble will be found in most cases.

Early prepyloric cancers are perplexing, for the antral narrowing that they produce may be imitated by that resulting from hypertrophy of the rugæ, benign ulcer with spasm, syphilis, or hypertrophy of the pyloric muscle (Figs. 7-*A*, 7-*B*, 7-*C*, and 7-*D*). Hypertrophic rugæ usually can be identified by their orderly arrangement, and gastric syphilis is so rare that ordinarily it can be excluded on an empirical basis. At the Clinic it has been found that pyloric hypertrophy almost invariably produces a slight invagination of the bulbar base and is marked also by a crevice near the middle of the lower border of the elongated pyloric canal. Both marks have a substantial morbid anatomic basis and rarely if ever occur in the other diseases named (Fig. 7-*D*). If a niche is demonstrable, the lesion is certainly an ulcer, but even then the examiner cannot be certain that it is not malignant.

Especially interesting are the small ulcerating cancers in which the element of tumefaction is so slight that they may be mistaken for simple ulcers. In 1921, Carman noted that in ulcerating carcinoma on the lesser curvature the barium-filled niche could be separated by manual pressure from the shadow of the stomach, and that it assumed the form of a bi-concave or concave-convex lens as seen edgewise (Figs. 8-*A*, 8-*B*, and 8-*C*). If the lesion was on the posterior wall, the niche could be disclosed by pressure as a disc-like shadow surrounded by a transradiant halo.

The shape and appearance of the niche led Carman to designate the phenomenon as the "meniscus sign," and he regarded it as a reliable sign of ulcerating cancer. Experience has abundantly confirmed his opinion, but if he were living to-day he would probably concede that the shape of the niche is less significant than the slightly elevated border which produces the transradiant halo (Fig. 8-*B*). Often the latter is demonstrable radiologically when it cannot be seen in the excised specimen. At all events, the meniscus-complex is practically pathognomonic of ulcerating cancer.

Malignant ulcer is a term conveniently reserved for ulcers that, in contrast with ulcerating carcinomas, present neither macroscopic nor radiologic evidence of tumefaction, yet on microscopic examination are found to contain cancer cells. It has long been accepted that when the diameter of the crater is 3 cm. or more, the ulcer is probably, but not invariably, malignant.

When the ulcer is smaller than this, other indications of malignancy have to be considered. Among these are irregularity of the niche, obliteration of neighboring rugæ, absence of gastrospasm or upward curling of the antrum, and lack of tenderness on localized pressure over the niche. Ulcers on the greater curvature are usually, but not always, malignant. Ulcers on the posterior wall or near the pylorus are more likely to be malignant than those on or near the mid-section of the lesser curvature. On the other hand, most niche ulcers are benign; usually the niche is dense, regular in form, lies in the midst of converging rugæ, is sensitive to pressure, and spastic accompaniments are common. Occasionally, however, an ulcer which seems almost certainly to be benign proves on section to be malignant. The effect of medical management (Figs. 9-*A* and 9-*B* and 10-*A* and 10-*B*) on ulcers is a valuable test of their character, but it is not infallible for in least one instance I have seen an ulcer apparently heal under medical treatment, recur after a few months, and when excised prove to be malignant.

I have emphasized the points of distinction between cancer and benign lesions because accuracy in their differential diagnosis is especially desirable. Nevertheless, in the interest of the patient, the examiner should be rather skeptical as to the benignancy of any tumor or ulcer of the stomach. Three-fourths of all gastric lesions exposed on the operating tables of the Clinic are found to be malignant. Unless the radiologist can affirm confidently that a lesion is benign, he should not return this diagnosis without qualification.

OPERABILITY

Concerning the radiologic criteria of the operability of gastric cancer, Carman was well informed. In his book he wrote, in substance, that cancers involving the upper half of the stomach are not resectable, as a rule, whereas those of the lower half are often resectable. He pointed out, also, that in judging the extent of scirrhous cancer liberal allowance must be made for infiltration beyond the limits indicated radiologically. Free mobility of the stomach, he said, favored resectability of the growth, but fixation made intervention less practicable. These and other pertinent statements in the chapter were written seventeen years ago, yet little can be added now. As a minor item I recall one case in which marked prolongation of the esophagus below the hiatus made it possible for the surgeon to perform total gastrectomy more easily.

That half or more of the gastric cancers are inoperable when discovered is deplorable. That they are so often inoperable is due primarily to the fact that early cancer, unless obstructive, often gives rise to few and petty symptoms or none at all, and the patient has no substantial reason for seeking medical aid. The only way by which such cancers can be revealed is by periodic health examinations, including radiologic investigation of the stomachs of all adults. In a certain percentage of cases the patient asks for advice, but his symptoms are so vague or trivial that radiologic examination seems superfluous. Nevertheless, only by this method can most of the early cancers be found or safely excluded. Obviously, an economic problem is involved, but if the number of examinations is greatly increased, as they should be, an adjustment of fees might be made so that the well-earned wage of the radiologist will not be lowered and the financial burden on the patient will not be onerous.

I congratulate the Radiological Society of North America on instituting this memorial to Russell Carman. His extraordinary ability, his great service to radiology, and his loyal devotion to this Society warrant sustained recognition. I am proud to hold the place that he once filled so ably at the Mayo Clinic, and I thank you for the privilege of participating in this tribute to him.

BIBLIOGRAPHY

(1) Akerlund, A.: Cited by Berg.
(2) Berg, H. H.: Roentgen Untersuchungen am

Innenrelief des Verdauungskanals. Georg Thieme, Leipzig, 1930, 198 pages.

(3) CANNON, WALTER B.: The Mechanical Factors of Digestion, page 5. Longmans, Green and Company, New York, 1911.

(4) CARMAN, R. D.: The Roentgen Diagnosis of Diseases of the Alimentary Canal, 2d ed., pp. 171–218. W. B. Saunders Co., Philadelphia, 1920.

(5) FORSSELL, G.: Cited by Berg.

(6) HOLZKNECHT, G.: Cited by Berg.

(7) KIRKLIN, B. R.: The Value of the Meniscus Sign in the Roentgenologic Diagnosis of Ulcerating Gastric Carcinoma. RADIOLOGY, February, 1934, **22**, 131–135.

(8) WILLIAMS, F. H.: The Roentgen Rays in Medicine and Surgery, page 360. The Macmillan Company, New York, 1901.

THE DEBT OF SURGERY TO ROENTGENOLOGY[1]

By DONALD C. BALFOUR, M.D., *Rochester, Minnesota*

Division of Surgery, The Mayo Clinic

MAY I first express my appreciation of the great honor of having a part in the inauguration of the Carman Lectureship which is to-day established by the Radiological Society of North America. The practice of commemorating those whose work has added to medical knowledge is evidence of a desire not only to recognize such accomplishment, but to encourage those of present and future generations in their efforts to further the advance of medicine. Since this Society has shown that it is conscious of these facts, I esteem it a privilege to aid in paying tribute to one of the founders of this association, Russell D. Carman, a master roentgenologist; and it will always be a treasured memory that you have accorded me the opportunity of being here on this occasion. Because of intimate association with Carman and my known admiration for his work, I had the privilege of inaugurating the lectureship established by the Minnesota Radiological Society, and the remarks made at that time are equally appropriate here.

Russell Daniel Carman was born at Iroquois, Ontario, March 18, 1875. After preliminary study in Minneapolis Academy, he took the first two years of the medical course in the University of Minnesota. Removing then to St. Louis, he completed his course in the Marion-Sims College of Medicine, receiving the degree of M.D. in 1901. For a year he did graduate work at Johns Hopkins Medical School, and then returned to St. Louis to practise. It was his first intention to take up orthopedics, but having a natural aptitude for the electrical arts, he was soon attracted to medical roentgenology, which was then in its early stages of development. By advancing with the science and working diligently and enthusiastically, he shortly became known as an exceedingly proficient and unusually reliable roentgenologist. He was a professor of roentgenology in the medical school of St. Louis University, and resigned later to accept the same post in Washington University. On invitation he joined the staff of The Mayo Clinic, Jan. 1, 1913, as head of the Section on Roentgenology, and continued in that capacity until his death in 1926.

The science of roentgenology having developed within the memory of members of the present generation, its true relationship to the control of chronic diseases which afflict members of the human race cannot easily be appraised; but it is a safe prediction that any present evaluation of the place of roentgenology in the science of medicine will, in retrospect, be found to be an under-estimation. Roentgenology has not only enabled the clinician to confirm his observations, but, more important, has given him information that is obtainable in no other way. It has made the impossible possible.

The application of the science has made it an essential factor in diagnosis in a greater number and wider variety of chronic diseases than is true of any other method, and this application is steadily becoming more comprehensive. Since the whole structure of therapeusis rests on accuracy of diagnosis, the importance of this fact cannot be exaggerated. The future medical historian, in judging the great benefactions to the health and happiness of mankind, must accord to roentgenology a place with anesthesia and antisepsis.

Many of the most serious diseases, notably cancer, frequently fail to give rise to any clinical signs or symptoms in their early stages, and roentgenology frequently

[1] Read before the Radiological Society of North America, at Memphis, Tenn., Dec. 3, 1934.

makes recognition possible at a time when there is the most favorable situation for bringing about cure. The presence of early pulmonary tuberculosis, of symptomless cancer of the stomach, or of certain lesions of the skeletal system, can in many instances be determined only by roentgenologic examination, and if there were some method of applying it routinely, countless deaths from these diseases could be prevented. The progress of roentgenology will, therefore, lie in its further development in detecting disease before clinical signs and symptoms are manifest, and a great impetus to this would be an inexpensive, efficient, and practical roentgenologic examination for detecting in the course of periodic health examinations these early deviations from normal, the control of which is so desirable in bringing about longer and healthier life.

This tremendous capacity for good must not conceal the fact that it is in interpretation of the revelations of the roentgenogram and fluoroscope that the sound development of the science lies, and the more keen the roentgenologist, the more he will realize that the significance of his findings must be judged by an astute clinician; just as the clinician will also demand skilled roentgenologic interpretation of his findings.

In no field of medicine are these facts more applicable than in the diagnosis of lesions and abnormalities of the gastro-intestinal tract, and particularly of the stomach and duodenum. Prior to the development of roentgenology, the difficulties confronting the clinician in the interpretation of symptoms directly or indirectly referable to the gastro-intestinal tract were so great that it was impossible to avoid misconceptions of the incidence, nature, and course of both benign and malignant lesions in this region. The work of pioneer roentgenologists indicates that many of these viewpoints could be clarified, and in this respect roentgenology has done more than any other factor to advance and perfect our knowledge in this field.

Since Carman's work was largely directed to the development of roentgenologic interpretation of lesions of the stomach and duodenum, it seems appropriate to discuss the debt of surgery to roentgenology by briefly summarizing the present status of our knowledge of diseases of the stomach and duodenum and their management, in the hope that in such a discussion roentgenologists may find some suggestions as to further possibilities in the development of their science.

It has been during the past twenty-five years that the progress of our knowledge in respect to lesions of the stomach and duodenum has been most rapid. In the first place, pathologists took advantage of the opportunity afforded by the surgeon of studying lesions in their various stages of development, rather than being confined to study of those lesions which had terminated the life of the patient. For this reason a more satisfactory classification of such lesions, from a pathologic standpoint, can now easily be made.

Great advances also have taken place in our knowledge of the physiology of the stomach, both in health and disease, and particularly in its motor and secretory functions. The clinical manifestations of disease have been better understood because of this pathologic and physiologic background and the known character of lesions in their various stages and their effect on gastric function.

Strangely enough, not yet is as much known about the uninterrupted clinical course of benign lesions of the stomach and duodenum as is desirable, in the first place because many of these lesions do not give sufficient symptoms to be recognized, and secondly because the course of the benign lesion is usually so chronic in a large group of cases that a much longer period of observation is necessary to get a true estimate of the prognosis. The great stumbling block is the lack of knowledge as to the cause of benign lesions of the stomach and duodenum, and in the absence of any known cause, theories are numerous.

The greatest impetus to our knowledge,

however, has been the accuracy of diagnosis, since all therapeusis must depend for its success or failure primarily on this, and it is in accurate diagnosis that the difference exists between quackery and scientific medicine. Since roentgenology has made such accuracy possible, it is difficult to overestimate the direct benefits of roentgenology to humanity. And, when it is considered that as yet no direct method, such as intragastric photography or visualization by gastroscope, has equalled in any respect what can be determined indirectly by roentgenology, one's amazement grows that any such method should attain such precision. To take advantage, therefore, of this precision, I shall attempt to outline briefly what appear at the moment to be some of the more important lesions of the stomach and duodenum and their treatment.

The most common lesion of either the stomach or duodenum is ulcer, and there are certain important facts which have significance to the clinician, roentgenologist, and surgeon. The lesion is very frequently multiple; in fact, in some recent reports ulcers or scars of ulceration have been shown to be present in 100 per cent of cases. It is this multiplicity of lesions and the constant tendency for such lesions to heal which is responsible for the great variety of deformities of the duodenum seen at operation. The most constant of these is the shortening of the duodenum that can be shown in all cases in which a lesion has undergone any attempted healing. Perhaps of greater interest to the roentgenologist is the pouching that may occur on either the superior or inferior border, or on both, and which sometimes results in what appears to be a true diverticulum. The most important consideration from a clinical standpoint, perhaps, is that by far the greatest number of the extensive lesions are on the posterior wall, and it appears that these lesions are the most difficult to heal, probably because they become easily fixed to retroperitoneal tissues, namely, in the head of the pancreas. When such fixation has occurred, healing seems almost out of the question. While inflammatory processes may occur in any situation, they are usually confined, however, to the first portion of the duodenum, and they exhibit lesions in every stage of development and healing.

One of the most interesting problems to the solution of which the roentgenologist contributes is that of duodenitis and its relationship to actual ulcer. It is, I think, commonly agreed that the inflammatory area of the duodenum may be, and probably is, the precursor of actual ulceration, so that the exact recognition of duodenitis by roentgen rays would be a very great accomplishment. The difficulty is that duodenitis is so frequently found to be associated with other lesions that management must be directed toward a multiplicity of lesions rather than toward a single inflammatory process. Just as the pathologic and physical characteristics of duodenal ulcer are variable, so the symptoms are exceedingly variable, and it is difficult in many cases to correlate these symptoms with the pathologic changes present. For the same reason treatment must be adjusted to these symptoms, so that it will vary from none at all being indicated, the lesion healing spontaneously, to removal of the inflammatory area with a substantial portion of the stomach to eliminate all known factors in the production of the lesion. Between these extremes, however, there are a number of measures designed for control. All these have the same purpose, namely, to provide as much rest as possible for the lesion and to so modify gastric function that sufficient rest will be maintained. In medical treatment this is attained by frequent feedings of a small, bland diet, with necessary alkalies, to control hyperacidity; from a surgical standpoint the same purpose is attained by various types of operations.

The roentgenologist will, with experience, find in the behavior of the stomach of the patient with duodenal ulcer certain suggestions as to what will be the most successful operation. When the patient has marked obstruction from duodenal

ulcer, impairment of motility, as shown under the fluoroscope, suggests, or at least very clearly indicates, that relief of this impairment will be all that is necessary. In this his supposition would be quite correct, because satisfactory results are obtained in cases in which there are such disturbances of function. When the stomach shows great hyperactivity, the operation of gastro-enterostomy, which is so effective when an obstruction exists, does not bring about as satisfactory results, for it is this very hyperactivity that makes possible the development of recurrent lesions. In this type of case, therefore, local operations on the outlet of the stomach are preferable, and in rare cases, when marked hemorrhage has occurred, some method of partial gastrectomy is desirable. Of these methods of partial gastrectomy, probably restoration of gastric continuity by uniting the stomach and duodenum is preferable to uniting the stomach and jejunum. The results of treatment of duodenal ulcer show it to be a disease that can be controlled, in from 85 to 90 per cent of the cases, by the co-ordinated efforts of the roentgenologist, physician, and surgeon.

Duodenal diverticulum is an example of a condition that can be detected only by the roentgenologist. It is true that only after it is found will a clinician assume that there are symptoms connected with the diverticulum, but these symptoms are so vague that I have never known a diagnosis to be made on clinical examination alone. The incidence of true diverticulum is about 2 per cent. Foreign bodies and benign tumors also can be detected only by roentgenologic examination.

Cancer of the stomach is a disease which may occur at any age, and various pathologic forms may involve any part of the stomach and vary greatly in virulence and in the symptoms produced. With all the discussion as to how more could be accomplished in attacking this serious problem, there is one fact that is more important than all others. That fact is that the hope of the patient with cancer of the stomach lies in the roentgenologist. This is for the reason that although in its early stages cancer of the stomach seldom gives rise to definite symptoms, usually there are sufficient signs and circumstances to arouse the suspicions of the discerning physician, and it is hoped that in the future the patient will be sufficiently educated to ask for the only method by which an early diagnosis can be made, namely, competent roentgenologic examination. The roentgenologist, therefore, probably has his greatest responsibility in this disease for the reason that it is in these early cases that removal is so much more likely to be followed by cure. There are certain aspects of cancer of the stomach which I think are particularly important. First, that while it is true that roentgen rays offer by far the best method of examination, it is also true that even in experienced hands a fairly advanced lesion may be overlooked. Therefore, I believe that when the clinician suspects cancer of the stomach and a single roentgenologic examination does not substantiate this opinion, a second examination or repeated examinations should by all means be made at an interval of a few days.

Again, with advanced carcinoma, the roentgenologist should co-operate with the clinician and surgeon in deciding whether exploration is worth while because of involvement of the upper part of the lesser curvature, since it is possible to remove the entire stomach and it has been shown that a patient can live in comfort with an anastomosis between the esophagus and jejunum or the esophagus and duodenum. I believe, therefore, that a patient with cancer of the stomach should never be dismissed as hopeless until there is a direct discussion of the whole situation with the roentgenologist. In the treatment of cancer of the stomach, curability, under the circumstances, should always be stressed, and when the disease is confined to the stomach, complete removal of the lesion at operation results in patients being alive and well at the end of three years in approximately 50 per cent of the cases. There are a great number of procedures for

dealing with gastric cancer, all being based on general principles, namely, thorough removal of the growth and restoration of continuity so that the anastomosis will function well.

Gastric ulcer is much less common than gastric cancer. Its well known predilection for the lesser curve at the angle is fortunate because this is a situation in which the lesion is readily accessible to surgical attack. It has been shown that those lesions on the greater curve are more likely to be malignant than benign, and for that reason they should perhaps be distinguished from those on the lesser curve. Lesions high on the lesser curve are perhaps of a less serious nature than those between the incisura and pylorus. There is still a good deal of confusion about the pathology of ulcerated lesions of the stomach, and I think this is largely unnecessary because as yet there is no way of determining by any gross methods of examination what the microscopic picture of a lesion is; however, more important contributory evidence has been brought by roentgen rays to differentiate malignant and benign lesions. Nevertheless I think one of the most important points in this respect was made by Carman when he adopted the practice of frequently referring to ulcers of the stomach as "lesions" rather than as "ulcers."

Caution should also be used in drawing deductions while observing the course of gastric ulcer by means of roentgenologic examination. It is well known now that the malignant ulcer may respond to intensive medical management not only in relief of symptoms, but also in decrease in size of the lesion, yet we have seen a number of cases in which the result of medical management has cost the patient his life, in that it seemed to prove the lesion was benign. The treatment of gastric ulcer should also take into consideration these possibilities, and in those cases in which surgery seems indicated the most important fact is that if the competent roentgenologist has identified the lesion in the stomach, however small, the surgeon is probably wrong if he fails to find it. I have been amazed on a number of occasions to find, after great difficulty, of course, a lesion awkwardly situated on the posterior wall and of such small size that it could be entirely overlooked had not the roentgenologist stated that it had been seen.

Gastritis is probably the most common of all conditions of the stomach, since it always accompanies in some degree any lesion whether malignant or benign. As yet in this country there has been no tendency to direct any surgical measures toward gastritis *per se*, but I believe one should keep an open mind as to the relation between gastritis and chronic lesions of the stomach, and we will probably again be indebted to roentgenology for establishing more accurate methods of determining the presence and degree of gastritis.

Benign tumors of the stomach are either symptomless or associated with secondary anemia, the source of which would entirely be unsuspected were it not for the visualization by roentgen rays. Since these tumors are often the cause of very serious injury to the blood, and since they can be readily removed by operation, with complete cure of the patient, roentgen rays can again be given the entire credit for the successful management of the condition. Again, with foreign bodies, and with gastric syphilis, the establishment of the diagnosis depends to a large extent on roentgenologic examination.

It has recently been shown that herniation of the stomach is a much more common condition than previously was thought, and while the symptoms of herniation through the esophageal opening have been studied by Harrington, and certain significant points have been established, again the only method of determining whether such herniation exists is by means of the fluoroscope. To emphasize the contribution in this field, one might say that during the past year 41 cases of herniation were identified as against approximately five cases twelve years ago.

The pylorus offers some interesting problems to roentgenology. By far the

most common secondary effect of intragastric and extragastric disease is pylorospasm, and there has been much speculation not only as to its significance as a reflex condition, but, and probably more important, as to its relationship to the development of intragastric disease, particularly peptic ulcer. I believe it is generally agreed that persistent and recurrent pylorospasm in some way disturbs gastric function, to an extent that inflammatory processes are not only more prone to develop, but are less likely to heal when marked pylorospasm is present. The detection, therefore, of pylorospasm, and of the various degrees of pylorospasm, would be an important contribution to our knowledge of the etiologic factors concerning peptic ulcer.

Another condition which has given rise to a good deal of interest and which is of much clinical importance, is hypertrophy of the pyloric muscle. We have seen some extraordinary examples of this condition among adults, in which hypertrophy was demonstrated by roentgenologic examination and was present beyond any question at operation, and from which the patients were completely relieved of symptoms (usually somewhat suggestive of ulcer) by permanent ablation of the muscle. The pylorus, and its effect on gastric function and its relationship to chronic disease, is, I believe, worthy of considerable further study, in which the roentgenologist will again play a prominent part.

The most difficult problems which present themselves to the clinician, roentgenologist, and surgeon are involved in those cases in which patients have not been relieved by operation of symptoms due to benign lesions, or in which secondary ulceration has developed. The clinician and surgeon are confused largely because the rule is that good results are obtained when operation is clearly indicated and properly performed. In cases of such secondary ulceration one is constantly dealing, therefore, with the exception rather than the rule, and to the problem of the lesion itself is added the necessity of evaluating the physiologic results of the operation. In a similar way the roentgenologist finds that in examinations of the stomach in which there is secondary ulceration interpretation is difficult. This is to a large extent the result of the fact that the correlation between the roentgenologic findings and symptoms in cases in which various types of operations have been performed is not as definite as in cases in which patients were not operated on, and one could very properly emphasize the danger of unwarranted deductions being made from what appeared to be deviations from normal in the roentgenologic findings. I have repeatedly seen patients, who had attained perfect results from operation and who had normal digestion, become disturbed because the roentgenologic report showed dilated intestinal loops or some deviation from normal in the emptying of the stomach.

It is just as true in the stomach and intestines as in the other parts of the body that, if normal function is present, form, position, and physical signs are not of much significance. Yet with all these difficulties of interpretation it is still true that roentgen rays offer the greatest help in these cases of secondary ulceration, and it is also true that the greatest co-operation between clinician and roentgenologist is necessary in such cases. The determination of whether the primary lesion has been reactivated or whether a new lesion has developed is of the utmost importance in the management of the patient. In those cases in which a short-circuiting operation has been done for an inflammatory process in the duodenum, and in which there is recurrence of symptoms, the surgeon is particularly interested in how the pylorus is functioning. It may be assumed in such cases that the inflammatory process in the duodenum, if the gastro-enteric stoma has functioned well, has healed, but since healing is always associated with some deformity, unwarranted deductions must not be made because such deformity is demonstrated by roentgen rays, and it is known that even considerable deformity in

the duodenum may be entirely consistent with good digestion.

The value of roentgen rays in this field is such that the experienced roentgenologist frequently is able to suggest to the surgeon what type of operation would probably be best in the case in which further surgery seems advisable. This group of cases, I believe, is the high mark in illustrating the place roentgen rays have in the diagnosis of lesions of the stomach and duodenum.

The debt to those who have developed this phase of science cannot be measured, and the Radiological Society of North America has added to its prestige by choosing to honor in this permanent way one of its members, Russell D. Carman, who will always be identified with that group of investigators who recognized the possibilities of roentgenology and who, by their industry, vision, and imagination, have carried it to such great heights. Carman possessed the true character of the pioneer. He was a prodigious worker, enthusiastic yet cautious; he was courageous in the face of difficulties and disappointments, determined to know the truth, and willing to sacrifice everything which might interfere with this purpose. He made it a practice to see at operation that which he studied by fluoroscope and roentgenogram, and I shall never forget the eagerness with which he viewed the field of operation to learn whether his diagnosis could or could not be confirmed. I never knew him, when he had made a positive diagnosis in an obscure case, try to persuade himself that a lesion was present which could not be seen by others; in fact, it often appeared that he seemed gratified if his diagnosis was not substantiated, for he realized that with any method which held such great potentialities for accuracy, its true value would be more quickly determined by encountering mistakes in diagnosis.

Carman's great contributions were in the field of gastro-intestinal diagnosis, and are recorded in his classic monograph. He was quick, however, to sense the limitations of roentgenology, and when the medical world became aware of the extraordinary accuracy of roentgenologic diagnosis of lesions of the gastro-intestinal tract, he was one of the first to point out that in certain cases roentgenology could determine only that a lesion was present, and that any attempt to specify its pathologic character might mislead the clinician and be responsible for unsound advice being given the patient.

On the occasion of Carman's untimely death, his life-long friend and associate, Albert Miller, wrote: "The world of the x-ray lost a master workman. For a time it will grieve that he is dead. For a longer time it will rejoice that he lived."

I feel greatly honored that I should be permitted the opportunity of being here and of congratulating the Society on the establishment of the Carman Lectureship, which will bring to all subsequent meetings of the Society the spirit of one who loved his profession and who exemplified the highest ideals.

INFLAMMATION OF THE DESCENDING PORTION OF THE DUODENUM

PRELIMINARY REPORT

By MARCY L. SUSSMAN, M.D., *New York City*

From the Department of Radiology, Mount Sinai Hospital; Service of Dr. Leopold Jaches

IT IS the purpose of the present report to emphasize the fact that duodenal inflammatory lesions occur distal to the duodenal bulb, and particularly in the portion between the knee and the papilla major. This is of importance because the clinical symptomatology is much like that of duodenal ulcer, but the duodenal bulb shows little or no change roentgenologically and a lesion in the descending portion of the duodenum is either not sought or difficult of demonstration.

Naturally, any study of the descending duodenum is based upon very limited pathologic material since few of these lesions are removed surgically. The present study includes eight cases in which the diagnosis of an inflammatory lesion of the descending portion of the duodenum was made roentgenologically. Two were operated on, but the information obtained was not very satisfactory and the conclusions arrived at in these cases must, therefore, be evaluated accordingly. In general, the cases could be grouped roentgenologically as follows:

(1) Stenosis and irritability of the descending portion alone.

(2) Stenosis with the demonstration of an ulcer crater within the stenotic lesion.

(3) Stenotic lesion in association with ulcer of the duodenal bulb.

(4) Stenotic lesion in association with gastric ulcer.

Outstanding features were: relatively slight to marked narrowing of the lumen of the duodenum between the upper knee and the papilla major, marked irritability, irregularity in outline or unusual smoothness, and a marked disturbance in the longitudinal mucosal folds so that they either disappeared or were irregular in their distribution as demonstrated by compression technic. In one case, what was interpreted as an ulcer crater, was demonstrated at one observation but not at a later period. The stenosis was usually not obstructive, suggesting that spasm played a considerable rôle in the roentgen appearance.

In all of our cases in which a Graham test was made, the gall bladder filled and emptied normally and no calculi were demonstrated; there was no history of jaundice nor biliary colic in any. This would make a diseased gall bladder unlikely as the source of adhesions. Differentiation of duodenitis from periduodenitis, essential or of gall-bladder origin, is difficult. In our experience, if adhesions are sufficient to produce stenosis, obstruction at that point is produced, with dilatation of the bowel proximally. Any irritability present under these circumstances is not constant and is probably due to spasm. It is stated by some, however, that adhesions may produce marked deformity of the duodenal outline and a more or less uniform narrowing of the lumen, the roentgen appearance of which is much like that of intrinsic inflammatory disease. This matter is further discussed below.

The clinical and roentgen differentiations of duodenitis from malignancy involving the descending portion of the duodenum, primary or secondary, may be very difficult. The duodenum is rarely involved in carcinoma of adjacent structures. Primary duodenal neoplasm is extremely rare. The chronicity of the disease, the absence of jaundice and of marked loss of weight, clinically suggest an inflammatory process. Roentgenologically, with tumor, there may be a widened duodenal curve. If there is stenosis, the lumen is more irregular the contour appears worm-eaten, and the lon-

gitudinal mucosal folds are much more distorted than in inflammatory disease.

Differentiation of ulcer of the descending portion from diverticulum may be difficult. The latter usually appears as a large pocket of barium, without stenosis, spastic or organic, and without irritability. The mucosal folds are not disturbed. The papilla major usually presents as a small filling defect on the inner side of the duodenal curve. Sometimes, there is a retraction of the papilla so that a small pouch of barium appears at this site; the differentiation is suggested by the location, its features being much like those of a small diverticulum. Pseudo-diverticulum, secondary to ulcer of the bulb, rarely leads to any difficulty in differential diagnosis.

Clinically, inflammation of the descending duodenum is much like duodenal ulcer and may be indistinguishable from it. However, analysis of our cases offers features which may suggest the differentiation in a given case. The pain, so characteristically regular in ulcer, in this condition is apt to be more irregular in time interval and intensity. Nocturnal pain, waking the patient from a sound sleep, has been described, and appears several times in our cases. Vomiting is not a common feature of duodenal ulcer, but attacks of nausea and vomiting are relatively frequent in inflammations of the descending portion: the patient is relatively well between attacks. Response to the Sippy diet is not as rapid nor as complete as might be expected. Judging from the literature, hemorrhage, on the other hand, although not prominent in our series, is a frequent finding, usually in the form of melena. The disease is extremely chronic but periodicity is not a prominent feature; it does not, however, lead to marked loss of weight. Hyperacidity is usually marked and prolonged but not necessarily so. When the disease occurs in association with a peptic ulcer, the symptoms of the latter are usually exaggerated.

The clinical symptomatology, then, suggests peptic ulcer. It is extremely important, therefore, in all such cases, to include a careful study of the descending duodenum whether a peptic ulcer is found or not. This remark must also apply to the exploring surgeon, since the pathologic changes to be observed are mucosal and submucosal, and opening of the duodenum cannot be expected to reveal an ulcer. It is proper to emphasize the necessity for routine observation of the descending duodenum roentgenologically in all cases, in order to be thoroughly familiar with the normal anatomy and variations.

Case 1 (364,454). Male, aged 37 years, was first seen on April 4, 1934, at which time he complained of nausea and vomiting two hours after meals. These symptoms accompanied a rather severe epigastric discomfort and had lasted for six weeks. There was no loss of weight. Physical examination showed no definite abnormalities. Hemoglobin was 86 per cent. Blood count showed no significant changes. Blood Wassermann was negative. Gastric content showed total acid, 80; free acid, 73. Stools, guaiac negative.

With bed-rest and a modified Sippy diet, there was a cessation of the nausea but the vomiting continued. Roentgen examination of the gastro-intestinal tract at this time showed (Fig. 1) a narrowing of the duodenum from the knee distally to about the region of the papilla. Projecting from the mid-portion of this region a patch of barium was seen which was interpreted as an ulcer crater.

After leaving the hospital, the symptoms recurred and have persisted. On Jan. 22, 1935, the involved portion of the duodenum was found roentgenologically to be even more narrowed, but the ulcer crater was no longer demonstrated. Graham test showed a normal filling and emptying of the gall bladder. No stones were demonstrated.

Case 2 (375,169). Male, aged 25 years, who complained of intermittent attacks of epigastric pain, radiating to the left shoulder, which were relieved by vomiting. The pain occurred two to three hours after meals. It had appeared in attacks for about seven years. Postural relief was a rather prominent feature. There was no

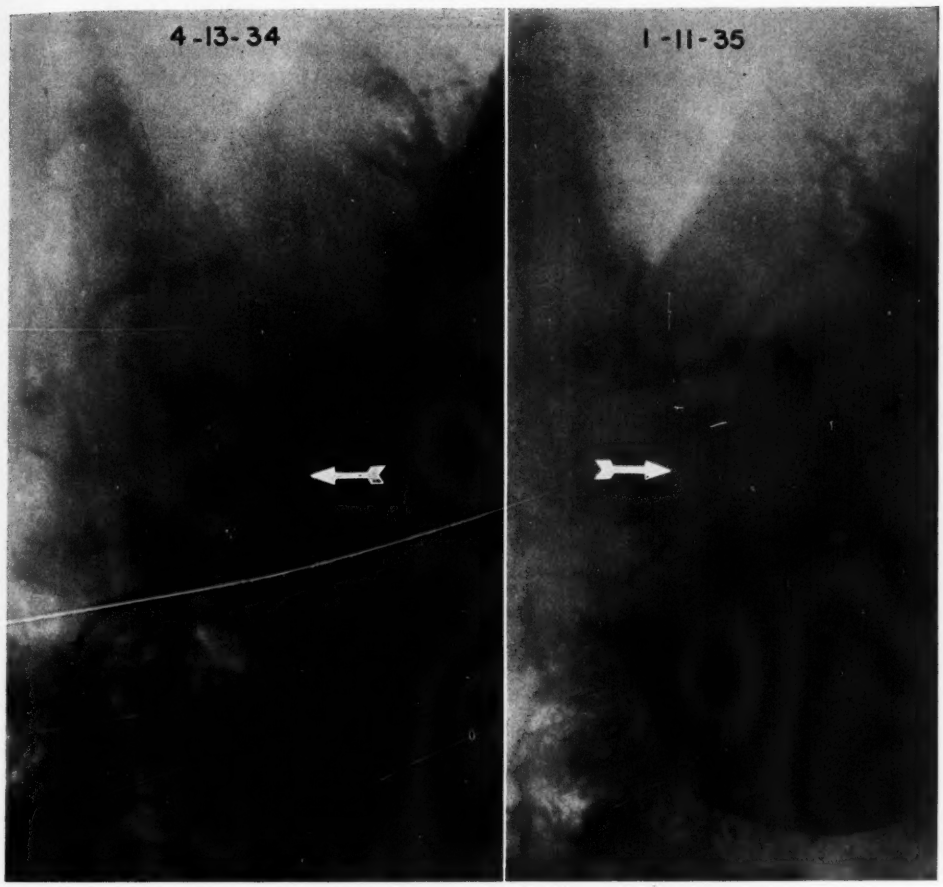


Fig. 1. Case 1. On April 13, 1934, there was a narrowing of the descending portion of the duodenum. Arrow points to a patch of barium thought to be an ulcer crater. On Jan. 11, 1935, the stenosis is more marked, and there is no demonstrable patch of barium.

loss of weight. Physical examination revealed moderate epigastric tenderness. Hemoglobin was 99 per cent. Blood count was essentially negative. Stools, guaiac negative. Gastric contents showed free acid 60, total acid 68.

The patient had been examined roentgenologically several times elsewhere during his illness and was reported variously as showing no lesion, a duodenal ulcer, and, lastly, an inflammatory lesion of the second portion of the duodenum. Graham test was negative, both in 1928 and in 1935. Roentgen examination, in 1935, showed the stomach and duodenal bulb to be normal in outline. The duodenum from the knee to about the region of the papilla major was narrowed; the degree of constriction varied, suggesting the presence of marked spasm and irritability (Fig. 2). There was no tenderness and no delay in gastric emptying. The patient had not responded to an ambulatory Sippy diet, but with rest in bed, in addition, he showed remarkable improvement.

Case 3 (367,593). Male, aged 30 years, was first seen in 1924, at which time, in addition to evidences of central nervous system syphilis, and epilepsy, he complained of epigastric pain more marked on the left

side, with tenderness and a burning sensation in this region. Vomiting within a half-hour after meals was a prominent feature. The patient was badly constipated. Gastro-intestinal series was reported negative. In 1924, he was explored and the report states that there were broad adhesions to the appendix, which was thickened, adhesions from the gall bladder to the duodenum, but a normal gall bladder, and an area of infiltration in the duodenum which surgically appeared fairly close to the pylorus. An appendectomy was performed: there was no relief of symptoms. In 1926, the patient was again explored, this time with negative findings. In 1935, a gastro-intestinal series showed a constriction of the descending portion of the duodenum; its contour was irregular, and the mucosal folds were distorted. Similar findings have been noted on several occasions during the previous years and were interpreted as being due to adhesions.

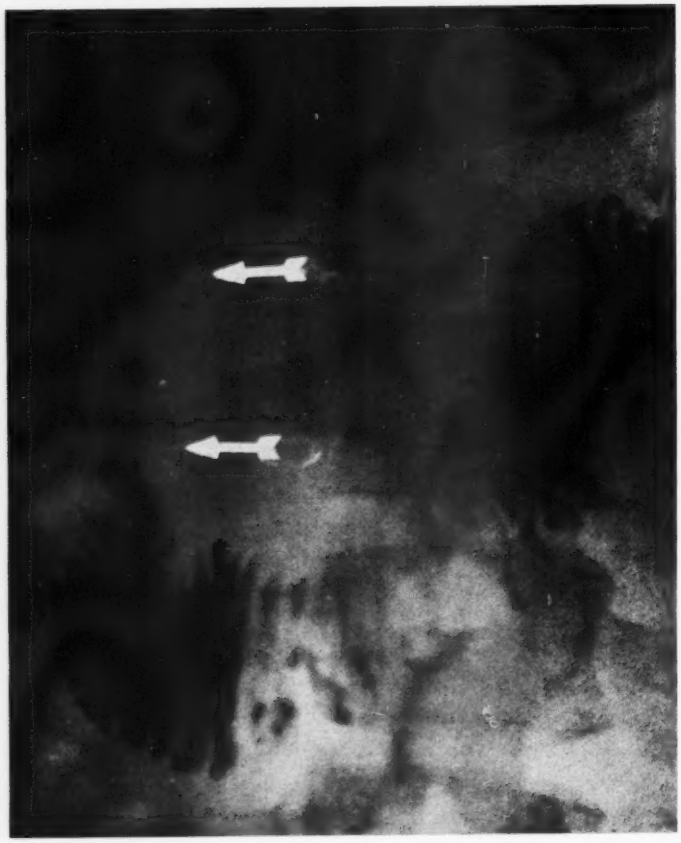


Fig. 2. Case 2. Marked narrowing of the descending duodenum from the knee to the region of the papilla.

Case 4 (35–1536). Male, aged 32 years. Three weeks before admission to the Outpatient Department, the patient experienced a sudden pain in the epigastrium which persisted up to admission, and came on chiefly one hour after meals. The pain radiated along the subcostal margin and woke the patient regularly at night. There was no vomiting and no melena. Stool, guaiac, negative. Gastric contents showed a total acid 70, free acid 60.

Roentgen examination of the gastro-intestinal tract showed no abnormality in the stomach. The duodenal bulb was con-

Fig. 3. Case 3. Marked irritability of the descending duodenum; distortion of the longitudinal mucosal folds, with irregularity in outline and moderate stenosis.

stantly irregular fluoroscopically and on the films. The duodenum down to the papilla was also irregular and spastic: there was moderate stenosis. The patient responded well to a Sippy diet.

Case 5 (377,811). Female, aged 32 years, was first admitted to the hospital in 1932, with a history of frequent vomiting immediately after meals, and attacks of severe, sharp epigastric pain, radiating to the back. The attacks of pain were said to have occurred about ten times a year for three years. There was anorexia and loss of about fifteen pounds.

The report of the roentgen examination of the gastro-intestinal tract at that time states that no abnormalities were found. There was a small gastric residue six hours after the meal. An exploratory laparotomy was performed at that time. The proximal half of the duodenum was found to be dilated. The reason was not determined, but a duodeno-jejunostomy was performed. The chart states that ten weeks after operation there was a recurrence of the epigastric pain, with difficulty in swallowing, belching and sour eructations.

Fig. 4. Case 4. Irregular duodenal bulb. Marked narrowing and irritability of descending portion of the duodenum.

In 1923, a constriction of the second and third portions of the duodenum was noted roentgenologically, with dilatation proximally. There was a 30 per cent gastric residue six hours after the meal. The case was clinically considered to be one of asthenia universalis congenita, with atony of the stomach.

In 1932, there was evidence suggesting a gastric ulcer at the re-entrant angle, which was demonstrated more definitely several times in 1934. In 1935, careful roentgen examination failed to show evidence of the gastric ulcer seen previously. There was, however, a slight constriction of the descending portion of the duodenum, with irritability and spasm. There was a moderate distortion of the mucosal folds. The duodeno-jejunostomy stoma functioned well. Gastric content showed total acid 40, free acid 25.

The patient is also a psychoneurotic, in view of which it is extremely difficult to evaluate the rôle of the duodenal lesion and of the previously demonstrated gastric ulcer in her symptoms.

Case 6 (CS 11/27/34). Male, aged 37 years, complained for four months of cramp-like pain localized to the epigastrium. This would be relieved by the ingestion of food, but would recur three or four hours later. Six weeks after the first visit he was put on a modified Sippy diet which relieved his pain, but the latter recurred if there were dietary indiscretions. There was a loss of 14 pounds in five months. Physical examination was essentially negative. Hemoglobin was 100 per cent. Blood count was essentially negative. Blood Kahn test was negative. Urine was negative. Stool examination after a free meat diet for three days was positive for occult blood. A Rehfuss test meal showed marked hyperacidity. A gastro-intestinal series showed a bilobed filling defect in the duodenum, just beyond the knee, in the center of which there was a pin-point collection of barium: there was marked irritability in this region. The duodenal bulb was apparently normal. The Graham test showed no abnormality in the gall bladder. The clinical diagnosis was duodenal ulcer.

Case 7. Male, aged 44 years, who two and a half years before the present examination, was awakened at 3 A.M. by a burning, rumbling sensation in the abdomen, which was relieved after ten minutes by gaseous eructations. This was repeated several times during the remainder of the night, awakening him from sleep each time. Since then he has noted epigastric oppression a half-hour after meals, relieved by gaseous eructations. One year before examination mucus was noted in the stools, but there was no evidence of melena. There has been a weight loss of 40 pounds in two and a half years. Physical examination was essentially negative. Hemoglobin was 80 per cent. Blood count, Blood Kahn test, and urine were negative. The basal metabolic rate was minus 14 per cent. The Rehfuss

test meal showed a moderate hyperacidity. Roentgen examination revealed an irregularity of the second portion of the duodenum, with slight narrowing and irritability. The case was clinically thought to be one of ulcer of the second portion of the duodenum. The possibility of a carcinoma of the pancreas could not be excluded.

Case 8. Male, aged 50 years, who complained for many years of attacks of epigastric pain. Recently there have been attacks of vomiting but essentially without pain. These episodes have been of two or three days' duration, and are apparently precipitated by dietary indiscretions. Between the attacks the patient is relatively well. There is no loss of weight. The maintenance of a modified Sippy diet did not prevent recurrence. The patient has been examined several times during these years and at all observations a marked deformity of the duodenal bulb has been observed. In addition, both in 1928 and at the present time, there is definitely demonstrated a narrowing of the descending portion of the duodenum, with spasm and irritability.

During recent years, there has been increasing interest in a subject which has been described under various titles, but particularly that of duodenitis. Judd and Nagel define this condition as a chronic inflammation of the duodenum without calloused ulcers. They differentiate duodenal ulcer and duodenitis, pathologically, as follows: In duodenal ulcer, the wall of the bowel is indurated and, if there is a slow perforation of the ulcer, tumor may form as the result of the defensive reaction of the surrounding tissues. When the intestine is opened, the ulcer crater is seen. In duodenitis, or submucous ulcer, there is congestion and stippling of the serosa, with little or no induration. There is no lesion of the mucosa, or, at most, small superficial abrasions. There is often a tendency to circular constriction of the bowel, but there is usually a question as to whether it is due to spasm or true narrowing.

Balfour notes: Inflammatory lesions of the duodenum are practically confined to

Fig. 5. Case 6. Bilobed filling defect in descending duodenum, with small patch of barium between the lobes.

the first two centimeters beyond the pylorus. Lesions seldom extend distally into the first portion of the duodenum (*i.e.*, distal to the bulb). Still more rarely do lesions involve the ampulla of Vater, and inflammatory processes beyond this point are almost unknown."

It is difficult to evaluate the literature on duodenitis since the term is used indiscriminately, either as defined above (Judd and Nagel, Kellogg and Kellogg), or in the more specific sense of an extra-bulbar inflammation of the duodenum (Robinson). The pathologic changes of duodenitis, whether limited to the bulb, to the pars descendens, or appearing in both, are apparently the same. Kellogg and Kellogg divided the general condition into three forms:

(1) A mild form, with slight edema and hyperemia, usually on the anterior surface just beyond the pylorus. There is a faint stippling when the serosa is rubbed. There is no deformity of the duodenum but there may be pylorospasm.

(2) A more advanced form in which the duodenum is red, hyperemic, and edematous, with marked stippling of the serosa.

(3) The duodenum is narrowed over a considerable area. There may be deformity of the duodenum but no stellate scars, irregular contractions, or punched-out lesions. There is a tendency to circular constriction of the bowel, but whether due to spasm or true narrowing is difficult to determine. All stages of superficial ulceration may be seen, from tiny abrasions to fissures, and ulcers of considerable size.

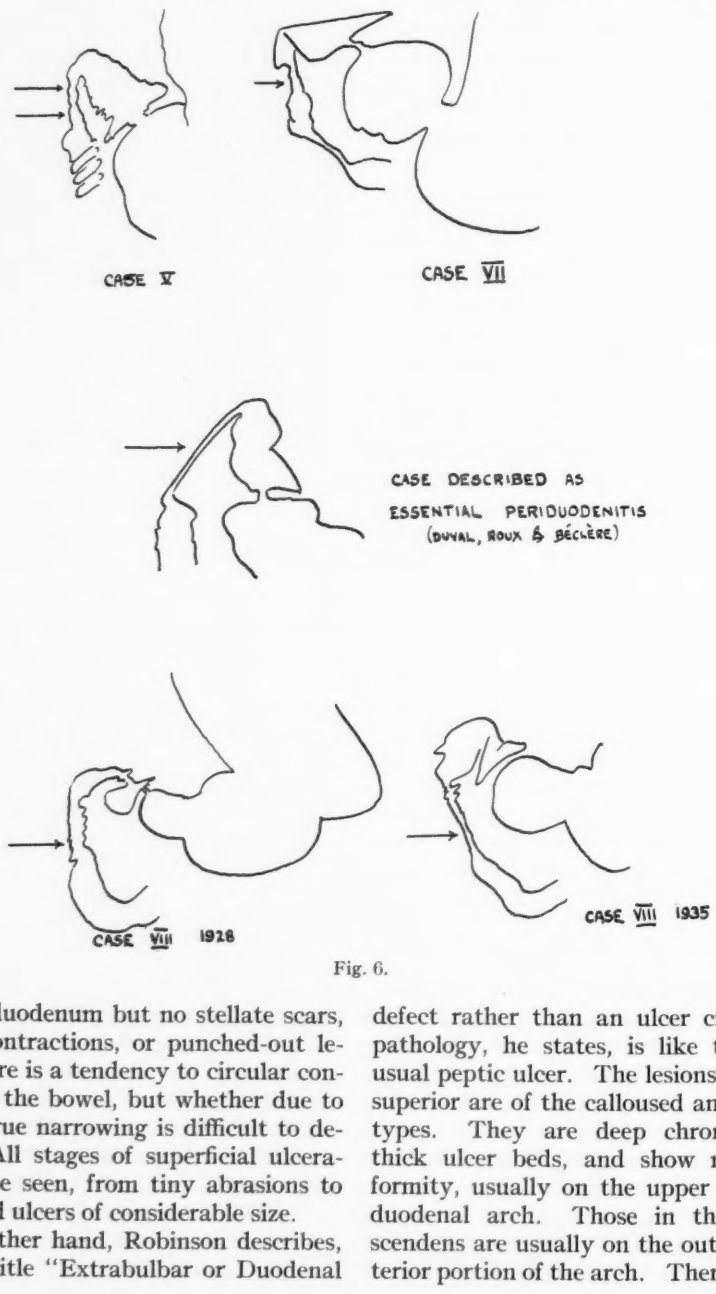


Fig. 6.

On the other hand, Robinson describes, under the title "Extrabulbar or Duodenal Ulcer," a group of cases with ulcer distal to the bulb. He states that most instances of this type of ulcer occur in the pars superior, but some are found in the pars descendens, where there is a constant peripheral filling defect rather than an ulcer crater. The pathology, he states, is like that of the usual peptic ulcer. The lesions in the pars superior are of the calloused and stenosing types. They are deep chronic craters, thick ulcer beds, and show marked deformity, usually on the upper side of the duodenal arch. Those in the pars descendens are usually on the outer and posterior portion of the arch. There is a tend-

ency to rapid healing, as in gastric ulcer. Robinson states that the process of repair is so rapid, especially in ulcers of the greater curvature, that, instead of a distinct niche at the time of the examination, a definite filling defect is found, due to cicatricial contraction of the fibrous connective tissue in the ulcer bed, with obliteration of the adjacent intervalvular space. Yet he did not observe stenosis of the lumen.

De Abreu has recently offered an excellent review of the subject of "Absteigende Zwölffingerdarm-Entzündung." He states that inflammation of the descending portion of the duodenum between the papilla major and the upper knee is not unusual, and is very often found in association with gastric ulcer, but more particularly duodenal ulcer. There are marked changes in the duodenal wall, thickening of the mucosa and the loose aveolar submucosa, due to edema and inflammatory infiltration. There is a marked increase in the connective tissue, with hyperplasia of the cellular elements and atrophy of the muscularis. As a result, the normal irregularities in the mucosa, the hills and valleys, are either accentuated and appear stiff, or become more or less smooth. De Abreu describes three forms: the stenosing, hypertrophic, and fibrous. In the stenosing form, there is a narrowing of the duodenum due to shrinkage of the connective tissue. The loss in elasticity also contributes, since the inflamed duodenum does not dilate during the passage of food or barium. The stenosing type is often associated with peptic ulcer or chronic inflammation of the stomach or pylorus. In the fibrous form, the descending duodenum is changed into a more or less thick tube with a smooth surface. The hypertrophic form is diagnosed with difficulty; pathologically, it corresponds to hypertrophic gastritis.

The contributions of Duval, Roux, and Béclère indicate, however, that the diagnosis of duodenitis cannot be made on clinical and roentgenologic grounds alone. They describe a condition of periduodenitis in association with gall-bladder disease and particularly cholelithiasis, with adhesions to the gall bladder and other surrounding structures. They also describe similar adhesions without any gall-bladder disease. They state: "This deforming periduodenitis is always stenosing in character although to a variable degree . . . . . The stomach usually empties itself in normal time." One of their cases is described as one of periduodenitis, with cholelithiasis and cholecystitis. Roentgen examination showed "a narrowing of the second portion with irregularity of the bulb, cap, and supra-mesocolic segment. The duodenum resumed normal caliber below. There was a closure of the genu superius." This case was operated upon, and dense adhesions with pericholecystoduodenitis were found. The similarity in the roentgen appearance to our Case 1 unquestionably introduces doubt into the diagnosis we have made. It must be realized, however, that the condition of the duodenum is difficult to establish by exploratory operation, especially if intrinsic inflammatory disease is not kept constantly in mind as a possibility. The matter can be definitely investigated only by microscopic examination of fresh pathologic material.

In regard to the clinical symptomatology of our cases, the review made by Sensenich is of interest. He summarizes the observations of Carlson, Wheelon, Ivy, Kelton, and others, and concludes that the reaction to experimental duodenal irritation in man is characterized by nausea and vomiting, produced more readily than with gastric irritation. There is also pain along the duodenum, corresponding to the point of irritation, which may be reflected under the liver. Headache, which may be severe, dizziness, faintness, chilliness, and palor are also described.

It is not within the realm of this report to consider at length the question of etiology or pathogenesis. The rôle of gastritis and duodenitis in peptic ulcer is still a moot point in pathology. The work of Konjetzny and others suggests that duodenitis is the precursor of duodenal ulcer; the former does not necessarily go over into the phase of duodenal ulcer. Smith and Tom,

on the other hand, call attention to the fact that Brunner's glands are seen almost exclusively proximal to the papilla major, and suggest that their friability and perhaps their selective excretion of certain toxins (*e.g.*, tobacco) may be of importance. Murray suggests that the hyperacidity may be explained by a pathologic irritation of Brunner's glands and excessive secretion of gastric hormone as well as entero-kinase, erepsin, and other enzymes. It is important to remember that "between the pylorus and the duodenal papilla, the gut presents characteristics which serve to distinguish it almost as a separate organ. It has a distinct embryologic origin, being derived from the foregut, whereas the rest of the duodenum belongs to the mid-gut. It has a blood supply through the artery of the foregut, the celiac axis, and not through the artery of the mid-gut, the superior mesenteric, which supplies the rest of the duodenum. It has no valvulæ conniventes, and possesses special glands which are met only here, the Brunnerian glands."

COMMENT

The cases described are presented because of their clinical and roentgenologic characteristics. These we have interpreted as indicating duodenitis, with or without an associated peptic ulcer. It is admitted that, in the absence of pathologic proof, the findings might be ascribed to a so-called essential periduodenitis. It is hoped that the preliminary presentation of this subject will lead to further interest and more definite information.

CONCLUSIONS

1. A brief review of the literature concerning inflammation of the descending portion of the duodenum is offered, and its relations to duodenitis and peptic ulcer are studied.

2. The roentgen characteristics are slight to marked stenosis of the bowel between the upper knee and the papilla major, irritability, irregularity or abnormal smoothness of outline, and disturbance or absence of the normal longitudinal mucosal folds. In some cases, an ulcer crater is seen. There is no organic obstruction. There may be an associated peptic ulcer.

3. The clinical symptoms of peptic ulcer are obtained but are exaggerated: often there is stress on nocturnal pain, nausea and vomiting in attacks, and poor response to a Sippy régime. Hyperacidity is a fairly prominent feature.

4. An appeal for careful study of the descending portion of the duodenum is made, particularly in routine cases, to determine the normal, and in cases with a suggestive history of ulcer, in which a lesion is not demonstrated in the stomach or duodenal bulb.

5. The diagnosis of inflammatory disease of the descending portion of the duodenum rather than essential periduodenitis, in these cases, appears to be the more satisfactory.

REFERENCES

(1) Balfour, D. C.: Diseases of the Duodenum and Their Treatments. Canadian Med. Jour., 1933, **28,** 2.

(2) De Abreu, M.: Absteigende Zwölffingerdarm-Entzündung. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1933, **48,** 547.

(3) Duval, P., Roux, J. C., and Béclère, H.: The Duodenum. Translated by E. P. Quain. Mosby, St. Louis, 1928.

(4) Judd, E. S., and Nagel, G. W.: Duodenitis. Ann. Surg., 1927, **85,** 380.

(5) Kellogg, E. L.: The Duodenum. Hoeber, New York, 1933.

(6) Kellogg, E. L., and Kellogg, W. A.: Duodenitis. Am. Jour. Surg., 1933, **21,** 368.

(7) Kirklin, B. R.: Duodenitis and its Roentgenologic Characteristics. Am. Jour. Roentgenol. and Rad. Ther., 1934, **31,** 581.

(8) Konjetzny, G. E.: Die Entzündugen des Magens. *See* Henke und Lubarsch, Handbuch der Speziallen Pathologischen Anatomie und Histologie. Springer, Berlin, 1928.

(9) Murray, M. M.: Small Intestine and Gastric Secretion, with Special Reference to Brunner's Glands. Jour. Physiol., 1930, **69,** 48.

(10) Robinson, W. W.: Extra-bulbar or Duodenal Ulcer. South. Med. Jour., 1934, **27,** 759.

(11) Sack, G. M.: Beitrag zur Magen- und Duodenal-Diagnostik. Röntgenpraxis, 1934, **6,** 451.

(12) Sensenich, R. L.: Duodenitis and Motor Disorders of the Duodenum. Jour. Indiana St. Med. Assn., 1932, **25,** 117.

(13) Smith, J. S., Kellett, and Tom, A.: A Note on Proto-duodenitis. British Med. Jour., 1933, **1,** 362.

THE TREATMENT OF EPITHELIOMA INVOLVING CARTILAGE USING 220 K.V.P. AND HEAVY FILTRATION[1]

By E. A. MERRITT, M.D., *and* R. RHETT RATHBONE, M.D., Garfield Memorial Hospital and Warwick Clinic, *Washington, D. C.*

From the Radiological Clinic of Drs. Groover, Christie, and Merritt

THE treatment of epitheliomas involving cartilage or bone, or recurrent epitheliomas that have been previously irradiated, has long been a difficult and usually an unsolved problem. A cancercidal dose of roentgen rays on such lesions with the usual method of lightly filtered or unfiltered rays has, if the lesion was extensive, produced trophic ulcers with cancer elements still present in the base. In cases in which the treatment has been successful so far as the malignant disease was concerned, the remaining ulceration with its chronicity and attending pain has not infrequently been of such a nature as to nullify the good accomplished.

Fig. 1. Case 1. Before treatment: cartilage is exposed.

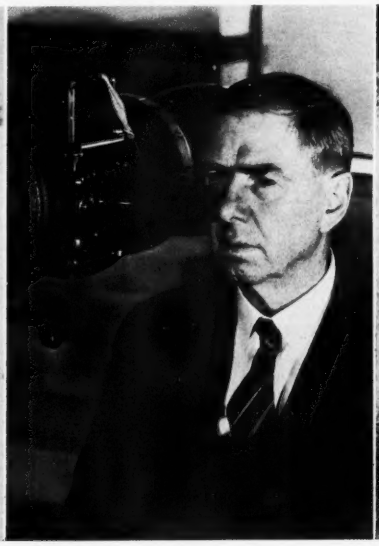


Fig. 2. Case 1. Method of treatment using 25 cm. cone.

Fig. 3. Case 1. Height of reaction, 11 days after treatment.

To illustrate this point let us review some opinions expressed at a Symposium on Cancer of the Skin at the Seventeenth Annual Meeting of the American Radium Society, in 1932. Taussig (1) stated: "It has been found that in instances in which cartilage or bone is involved, irradiation in effective dosage is apt to produce painful and intractable reaction. This fact makes it inadvisable to irradiate growths of the ear or of the ala nasi."

At the same meeting, Cutler (2) stated: "The treatment of cancer of the skin, which has been previously irradiated but uncontrolled, constitutes a serious and difficult phase of treatment of skin cancer. Some leading radiotherapeutic clinics refuse to undertake radiation treatment of recurrent carcinoma following previous inadequate radiation therapy."

Electrothermic surgery has in many clinics supplanted sharp dissection. However, in large lesions it has the disadvantage of extensive scarring, which often necessitates plastic surgery.

[1] Presented before the Radiological Society of North America, at the Twentieth Annual Meeting, at Memphis, Tenn., Dec. 3–7, 1934.

Surgical excision has, for the most part, been unsatisfactory. Were this not so, there would be no occasion for an attempt at developing other methods of treatment.

Heavily filtered radium element (1 or 2 mm. platinum) as advocated by Pfahler and others represents a distinct advance in the treatment of this type of lesion. However, its use has been restricted to a very few clinics, which are proportionately insignificant when compared to the vast numbers of persons suffering from extensive superficial cancers.

For several years we have used various technics in the roentgen-ray treatment of extensive superficial malignant lesions, and because of the uniformly good results we believe that heavily filtered roentgen rays at voltages at or above 200 K.V. represent a distinct advance in superficial cancer therapy.

TECHNIC

220 K.V.P. 20 ma. 25 cm. distance
2 mm. Cu and 1 mm. Al filter half layer value 2.06 mm. Cu 63 r per minute[2]

or

Thoræus filter half layer value 2.00 mm. Cu 76 r per minute

Area	Daily dose	Total dose	Total time
1 × 1 cm. to 3 × 3 cm.	350 r	6,000 r	19 days
3 × 3 cm. to 7 × 7 cm.	300 r	5,000 r	18 days
7 × 7 cm. to 10 × 10 cm.	250 r	5,000 r	20 days
10 × 10 cm. to 15 × 15 cm.	200 r	4,500 r	22 days

We use 220 K.V.P. and 20 ma., because the additional 20 K.V.P. improves the quality and intensity slightly, with heavy filtration, over 200 K.V.P. and 25 milliamperes. Taylor (3) analyzed one of our copper absorption curves and states that the voltage at 220 K.V.P. is "180 K.V. equivalent potential, using 0.22 mm. Cu filtration." We use a 25 cm. distance, as it is the closest convenient working distance with our flexible shockproof tube holders. We employed a 50 cm. distance before the advent of shockproof tube holders with equally good results—the distance is now decreased merely to save time. The intensity has varied from 16 r to 76 r per minute. Contrary to the experience of others, we have observed no difference in results or skin reactions with this wide variation in intensity. We are convinced that the minimum filter which should be used is 2 mm. Cu or its equivalent Thoræus tin filter. We have tried less filtration and the results are not satisfactory. Trophic ulcers are certain to develop if the dosage in the chart is given with filtration less than 2 mm. Cu.

We have treated 12 cases, using filters varying from 0.25 mm. Cu to 1.0 mm. Cu, and in this group four trophic ulcers developed and in all cases there was excessive skin damage and slow healing. We are indebted to Dr. Bloodgood for a successful treatment of trophic ulcers that controls the pain and rapidly cleans up the slough. Periodically, the loose necrotic tissue is cut away with scissors, and 90 per cent phenol is applied until the tissue turns white; it is then neutralized with 95 per cent alcohol. This is continued until the slough disappears.

Many radiologists and physicists have for years maintained that 0.5 mm. Cu is the practical and useful limit in filtration at 200 K.V.P. Our clinical experience during the past two years forces us to abandon this idea. In fact, we are now convinced that 2 mm. Cu should be the minimum filtration for 200 K.V.P. therapy in the treatment of malignancies, and as soon as the voltage can be raised economically, our minimum filter will be increased. All treatments are given daily except Sunday, and usually in a minimum of 19 days and a maximum of 22 days. At least 1 cm. of healthy tissue is irradiated beyond all visible and palpable evidence of malignancy. If there is any doubt as to the extent of the lesion, it is perfectly safe to irradiate several centimeters of healthy skin margin. Biopsies are taken on all cases after they have been given approximately 1,000 r. Biopsies are done to substantiate the clinical diagnosis. We do not let them influence our dosage, as many times our pathologist has reported squamous-cell carcinoma in one portion of

[2] All roentgens in this paper are measured in air.

Fig. 4. Case 1. Healed, two months after treatment.

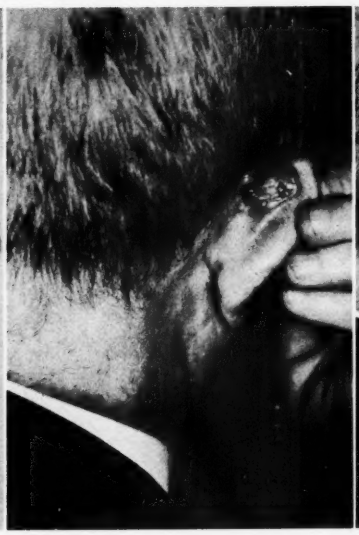


Fig. 5. Case 2. Before treatment, cartilage is exposed.

Fig. 6. Case 2. Completely healed, two months after treatment. Healed now, 10 months.

Fig. 7. Case 3. Before treatment.

Fig. 8. Case 3. Completely healed, five months after treatment. Healed now, 15 months.

the section and basal-cell carcinoma in another. Each case gets the maximum dose, as we know it will destroy the most resistant skin carcinoma and is safe in the radiosensitive types.

The daily dose depends on the size of the area treated. It is our experience that the minimum total dose by this method which will destroy squamous-cell carcinoma and adenocystic basal-cell carcinoma is an intense blistering or epithelitis. This epithelitis usually begins about the day the

treatment is concluded and, as a general rule, heals from three to six weeks later.

We find that all patients tolerate these intense blistering reactions without objection if told before the treatments are instituted that their skin is going to be blistered just as though it were intensely sunburned. If the epithelioma has destroyed a large amount of tissue, this fills in slowly until complete healing occurs. We have seen exposed, eroded cartilage completely recovered with normal, healthy mucosa or skin. During the period of treatment and healing, secondary infection must be avoided by instituting a strict régime of cleanliness. Hydrogen peroxide, dilute alcohol, soap and water irrigations, mercurochrome, green soap and H_2O_2, equal parts, are the agents we commonly use. Following the twice daily cleansing, nupercainol ointment 1 per cent is applied with white vaseline to control the burning and itching.

It is now possible for us to successfully irradiate lesions that in the past we considered radioresistant. We have, in fact, acquired a new concept of "x-ray fast" lesions. *In our more recent experience such lesions have proven to be inadequately treated cancers.* Cases that supposedly have had the maximum amount of irradiation without cure, and do not actually have a trophic ulcer present, can be safely and successfully treated. Extensive epitheliomas involving cartilage have given brilliant results. Using this technic, in the 25 cases we have thus far treated, we have had only two trophic ulcers develop. One was due to secondary infection caused by lack of cleanliness; the other was treated early in our series, and we have since learned that it was over-treated. We have had one marginal recurrence one year after treatment, due, we believe, to treating too small an area. Twenty-three of the 25 patients have been free from complications and all evidence of carcinoma from three to twenty-seven months.

Fig. 9. Case 4. Before treatment, cartilage is exposed. Note telangiectasis on cheek from previous roentgen treatment.

Fig. 10. Case 4. Beginning blistering reaction, five days after treatment.

The success of this method is primarily dependent upon two factors, but the problem is so complex that we are unable to state which factor is the more important—the heavy filtration (2 mm. Cu) or the fractional treatment. We believe that both are essential. This form of treatment produces a reaction which is entirely unlike the usual x-ray reaction with light filtration (Al filters or 0.5 mm. Cu) given in a few

days' time. The reaction is relatively painless compared to its appearance and intensity. The most important part, however, is the complete destruction of all surface epithelium and carcinoma cells, with a minimum damage to the dermis and supporting skin structures. We believe there is a different biologic reaction to these short wave lengths. Whether or not this is an actual or apparent biologic specificity to short wave lengths we do not know. *The important point is that we do get a different skin and subcutaneous reaction so that the lethal threshold between skin and dermis is widened.*

Fig. 11. Case 4. Healed, two months after treatment.

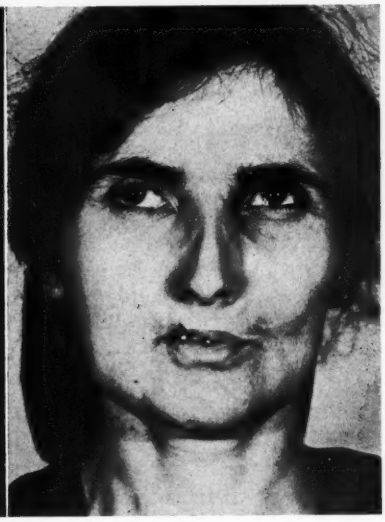


Fig. 12. Case 4. Present condition showing rubber compound nose. Healed now, one year.

CASE REPORTS[3]

Case 1. W. S. H., a white male, private patient, aged 67 years. At the onset, in 1924, there was a small nodule on his nose. This was removed surgically, in 1925 but recurred soon after. During the next seven years he had an average of three radium treatments yearly. It never permanently healed. His referring physician thought the patient must have a trophic ulcer because of intensive and prolonged radium treatment (Fig. 1). Biopsy reported transitional cell carcinoma.

The treatment given was as follows: 220 K.V.P.; 20 ma.; 25 cm. distance; Thoræus tin filter; 2.5 cm. portal; 380 r daily, 76 r per minute; time, 5 minutes; 5,700 r total dose in 18 days' time.

Figure 2 shows the shockproof tube holder with a special cone for 25 cm. distance. Figure 3, eleven days after treatment, shows a normal blistering reaction which subsided 25 days after treatment. Figure 4 shows the lesion completely healed two months after treatment: it has been well now for three months. This recent case illustrates two points, first, the referring physician thought the patient had already received the maximum amount of irradiation and had a trophic lesion. In spite of this previous irradiation we were able to safely administer a cancercidal dose of x-ray without breaking down the nasal cartilage. Second, a so-called resistant lesion responded to this dosage—it had merely been inadequately treated previously.

[3] Fourteen cases were presented before the Radiological Society of North America. Space limitations allow the presentation of only four here.

Case 2. E. H., a white male, private patient, aged 70 years. Onset in 1927, as a small hard nodule behind the right ear where the ear piece of spectacles had irritated the skin. No treatment was given other than home remedies. The lesion has alternately healed and ulcerated for the past five years. (Fig. 5, before treatment.) Biopsy report was transitional carcinoma cell.

The treatment given was as follows: 220 K.V.P.; 20 ma.; 25 cm. distance; 2 mm. Cu plus 1 mm. Al filter; 4 × 4 cm. portal; 300 r daily, 75 r per minute; 4 minutes' time, 4,800 r total dose in 22 days' time. The height of the reaction was a painless, blistering which was obtained 10 days after treatment; the reaction subsided in four weeks. (Fig. 6, completely healed in eight weeks.) It has been healed now 10 months. Perfect cosmetic result without sacrifice of any portion of the ear.

Case 3. This case is presented as an example of the successful treatment of a resistant lesion that had previously been inadequately treated by ourselves over a five-year period. G. M. C. a white female, private patient, aged 44 years. Onset, in 1928, as a small crusted papule on the left temple. First treatment: the lesion was destroyed by electrodesiccation in February, 1928; there was a recurrence in 1929. The second treatment was 30 mg.-hrs. unfiltered radium contact distance. There was a recurrence in 1930. At the third treatment the lesion was destroyed by electrodesiccation—area 2 cm. in diameter. The fourth treatment, in 1930, destroyed by electrodesiccation; recurrence in 1931. The fifth treatment destroyed by electrodesiccation; recurrence in 1931. The sixth treatment, in 1931, was 2,900 mg.-hrs. radium, 0.5 mm. lead filter, 2 cm. distance. The lesion failed to heal. The seventh treatment, in 1932, consisted of a total of 1,235 r in four treatments at three-week intervals, filtered through 5 mm. Al. The lesion failed to heal. A consultation was held, and it was decided that the lesion was lupus vulgaris. The patient was given potassium iodide for 10 months, during 1933, with some improvement. In November, 1933, the lesion was 3 cm. in diameter. Biopsy report was a basal-cell carcinoma. It was decided to give the patient deep therapy, with heavy filtration. Figure 7 shows the lesion before treatment. The eighth treatment was as follows: 220 K.V.P.; 20 ma.; 50 cm. distance; 2 mm. Cu plus 1 mm. Al filter; 4 × 4 cm. portal; 250 r daily, 22 r per minute; 11.5 minutes' time; 5,000 r total dose in 23 days' time.

The height of reaction was blistering 10 days after treatment. Figure 8 shows the lesion completely healed five months after treatment. Healing was slow due to many previous treatments and poor blood supply: healed now (15 months).

Case 4. R. D. C., a white female, private patient, aged 48 years. Onset, in 1924, as a small ulcer on the right side of the nose. It was destroyed by electrodesiccation, but failed to heal. Had weekly x-ray treatments for several months until blistering reaction was produced. Patient thought she was "burned" and refused further x-ray. The lesion never healed. In 1928, a destructive paste was applied which destroyed a large portion of nose. There was no further treatment until referred to us. Figure 9 shows the lesion before treatment: note telangiectasis from former x-ray treatments, also exposed, eroded cartilage. Biopsy report was transitional cell carcinoma. The treatment was as follows: 220 K.V.P.; 20 ma.; 50 cm. distance; Thoræus tin filter; 5 × 5 × 2 cm. portal 300 r daily, 24 r per minute, 12.5 minutes time, 5,000 r total dose in 20 days' time (Figs. 10 and 11). The patient complains only of a sore tongue. The exposed cartilage shown in Figure 11 was completely recovered two months later with healthy mucosa. Figure 12 was taken nine months after treatment, showing a rubber compound nose modeled by Dr. William Meloy; healed now (one year). The patient worked daily during treatment, except that during the blistering stage she took one month off. During treatment and until healing occurred the nose was irrigated twice daily with 2 per cent soda bicarbonate solution. This case

is an example of several we have had showing that this cancercidal dose of x-rays can be safely administered in cases in which there is telangiectasis and trophic changes from previous irradiation. This patient also demonstrates how the exposed, eroded cartilage is completely recovered by normal mucosa after the malignancy has been destroyed.

REFERENCES

(1) TAUSSIG, LAURENCE: Treatment of Epithelioma of the Skin. Am. Jour. Roentgenol. and Rad. Ther., December, 1932, **28,** 721–723.

(2) CUTLER, MAX: Radiation Therapy of Cancer of the Skin. Am. Jour. Roentgenol. and Rad. Ther., December, 1932, **28,** 724–727.

(3) TAYLOR, LAURISTON S.: Personal communication.

OSTEOGENIC SARCOMA[1]

ROENTGENOLOGIC CHARACTERISTICS

By R. T. WILSON, M.D., F.A.C.R., *Temple, Texas*

OSTEOGENIC sarcoma may be defined as a primary malignant tumor derived from tissues which normally produce bone. Naturally most of these arise in bone, but recent reports (1) in the literature indicate that bone-forming malignant tumors have been observed in the thyroid gland and other organs not associated with bone. If it is true that any primary bone tumor may be regarded as a potential malignancy (2), and if, in spite of all known therapy, the disease carries an unusually high mortality rate, it is obvious that most earnest consideration of this rare disease is justifiable.

From the reports in the literature, one is impressed with the comparatively small number of primary bone malignancies encountered, even in the large clinics. Doubtless, there are many in this assembly whose experience with this rare disease far exceeds that of the writer, and it is not presumed that any new development will be presented. The purpose of this paper is, then, to record a limited experience, and to reiterate some of the well-known facts and thereby, if possible, to encourage further interest in this sector of malignant disease.

The great volume of literature written in recent years would seem to indicate a revival of interest in this subject. This has doubtless been stimulated by the establishment of the Bone Sarcoma Registry by the American College of Surgeons. The good work which this organization is doing is to be commended, and it is hoped that through this or some such means there may be established a more hearty co-operation of all practitioners who deal with this condition. It is hoped to develop thereby a greater diagnostic accuracy and a more effective therapeusis.

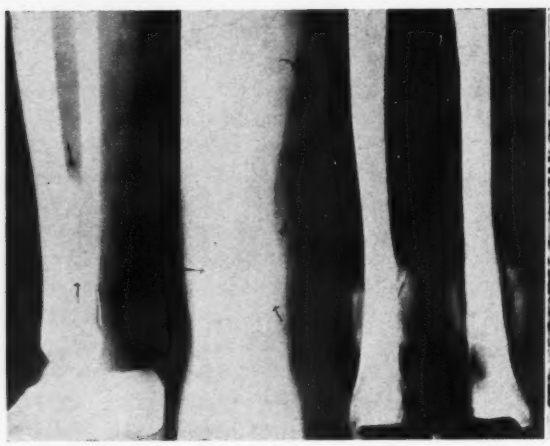


Fig. 1.

Fig. 2.

Figs. 1 and 2. Case 1. Mrs. C. T. T., Jr., aged 22 years (Reg. No. 72843). A fusiform osteogenic sarcoma —periosteal type, Grade II.

The first thought in connection with malignancy is the conservation of life, and in osteogenic sarcoma the conservation of limb also, since the majority of these tu-

[1] Presented before the Radiological Society of North America, at the Twentieth Annual Meeting, in Memphis, Tenn., Dec. 3–7, 1934.

Fig. 3. Case 2. Mr. T. R. C., aged 35 years (Reg. No. 75476). Medullary and subperiosteal osteogenic sarcoma.

mors occur in the long bones of the extremities.

In 17 years there have been 210 primary tumors of bone recorded in the Scott and White Clinic from a total of 144,889 clinic registrations, or approximately one in 690 admissions. Of these 210, there are 35 which have been classified as malignant, through the criteria of history, physical examination, and roentgenologic study. In addition, 23 of the 35 have had biposy, post-operative, or postmortem pathologic examinations. Thus it will be seen that in this institution one primary malignant bone disease has been encountered in approximately 4,000 clinic admissions.

Roentgenology has contributed to a better understanding of this condition, because it offers a superior method of skeletal examination, but it is to be remembered

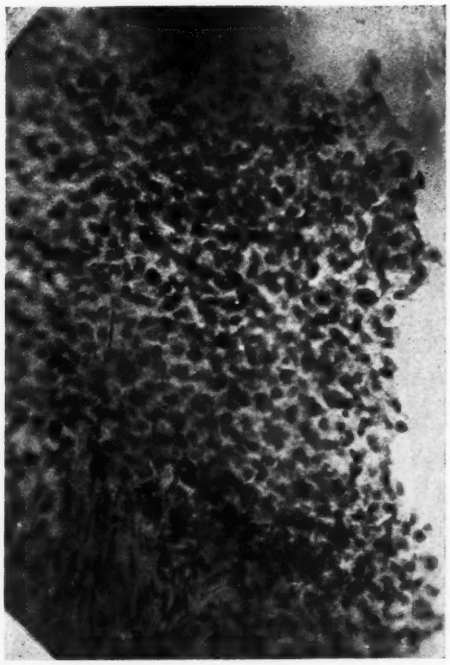


Fig. 4. Case 2. Photomicrograph of tissue.

that there are yet some unsettled problems in relation to classification. Some of the earlier writings, after the advent of roentgenology, would indicate that the lines of distinction were sharply drawn between the benign and malignant groups, and that the further subdivision of these two classes might be comparatively easy. However, the frank confessions of the more recent articles would indicate that not all the problems are yet settled. Even the more experienced men are sometimes perplexed, as they often find that features which have been conceded as peculiar to certain forms of the disease, may also be found in other forms. In a recent discussion at the Southern Medical Association, a prominent roentgenologist remarked: "Ten years ago I could make a differential diagnosis, but now I confess I cannot always do so." Goodwin (3) states: "There are osteogenic sarcomas, the diagnosis of which is quite plain from the clinical and roentgenologic studies. Again, there are tumors which show such variations that the methods of diagnosis, including biopsy and radio-

Fig. 5. Fig. 6.

Figs. 5 and 6. Case 3. Mr. L. G. M., aged 63 years (Reg. No. 78895). Chondroma with myxomatous regression involving astragalus.

therapy tests, leave one in doubt as to the true nature of the cases. To err one way may mean the loss of a patient who might have been saved by early radical means. To err the other way may result in an unnecessary, mutilating operation."

A clinical conference with colleagues for consideration of history, symptomatology, and physical features may often clarify a difficult situation, and doubt may still exist even after microscopic study. If the latter be necessary for final decision, it should, of course, be done in a manner that will conserve the patient's best interests and not lessen his chances for improvement or recovery. It is predicted that through the co-ordinated efforts of the roentgenologists, pathologists, and orthopedic surgeons these perplexities may be simplified in time, resulting in greater conservation of life and limb.

Whether encountered incidentally or in a direct search for bone pathology, the roentgenologist's problem may be concisely stated as follows: Are changes depicted here due to developmental anomaly or to an acquired process? If acquired, is the condition one of acute infectious origin or of a neoplastic character? If the preponderance of evidence is in favor of neoplasm, then is it benign or malignant, primary or metastatic? Even these classifications are not always easily made. For instance, osteomyelitis, especially the more chronic sclerosing cases, may simulate Paget's disease or even Ewing's tumor, and sometimes it is difficult to distinguish giant-cell tumor, cyst, and osteochondroma.

In general, the benign nature of a bone lesion is usually determined on the basis of the very dense bone structure, the confinement of the growth to the shaft (though this may be expanded), and the more liberal bone production about the margins of the diseased process; whereas, for the most part, malignancy exhibits destruction of the substance, changes in the medullary and cortical arrangement, elevation or destruction of the periosteum, expansion of the cortex, erosion of the cortex, and irregular deposits of new bone through a soft tissue mass outside the shaft.

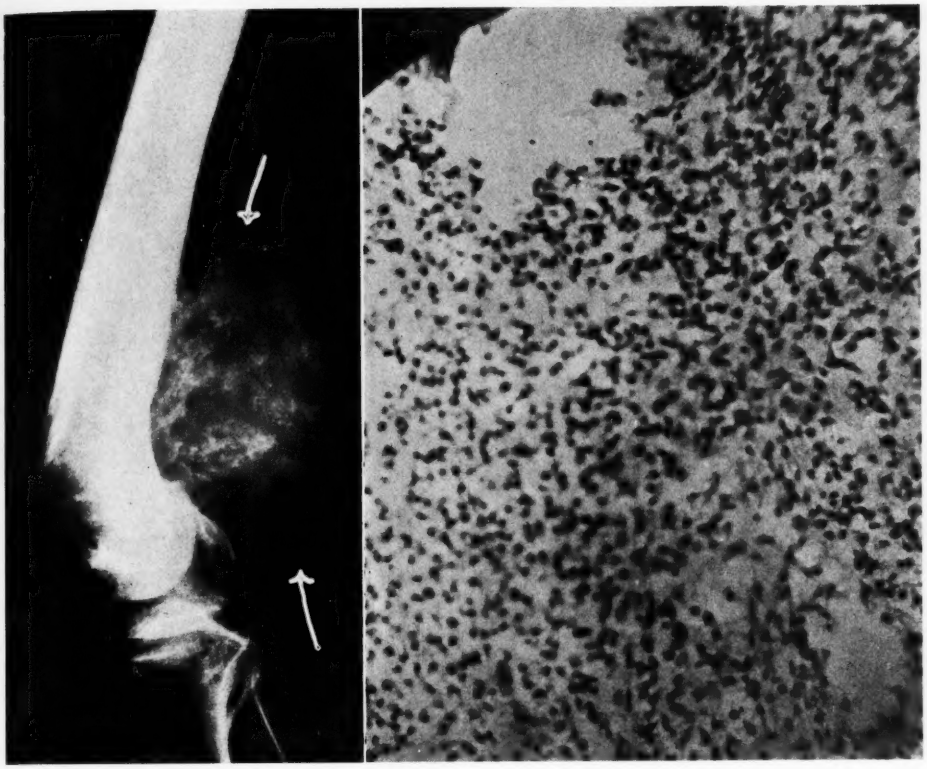


Fig. 7. Fig. 8.

Figs. 7 and 8. Case 4. Mr. S. H. R., aged 46 years (Reg. No. 72931). Periosteal chondrogenic sarcoma, lower end of femur.

These bone tumors appear, as a rule, in young persons. The average age of our cases was 30.7 years, ranging from eight, the youngest, to 69, the oldest. Fifty per cent gave a history of trauma. Thirty-two of the 35 had pain. The average length of history is seven months, if we except one patient whose trouble began 34 years previously with injury.

Case 1. Mrs. C. T. T., Jr. (Reg. No. 72,843), aged 22 years, minister's wife, was admitted to the Scott and White Clinic, Aug. 22, 1929, with the chief complaint of swelling in the lower third of the right leg. Three and one-half months previously she had sprained her right ankle. Three weeks after the injury, two distinct, painless tumors formed, which apparently did not increase in size until one month previous to admission, when they began to grow. One week before admission, the leg became extremely painful.

Physical examination revealed nothing of significance except that the lower third of the right leg was definitely swollen—there was a slight increase of local temperature, but there was no discoloration. The skin over this area was tight and shiny. Two small tumors were found which seemed firmly attached to the bone. There was a slight anemia; the hemoglobin was 70 per cent, the red blood cell count was 4,128,000. The roentgenogram of the chest was negative. Roentgen-ray examination of the leg showed an elevation of the periosteum of the tibia on both the inner and outer aspects of the bone, involving the greater portion of the lower third, and on the inner side there was a slight erosion of the cortex at one point. A soft

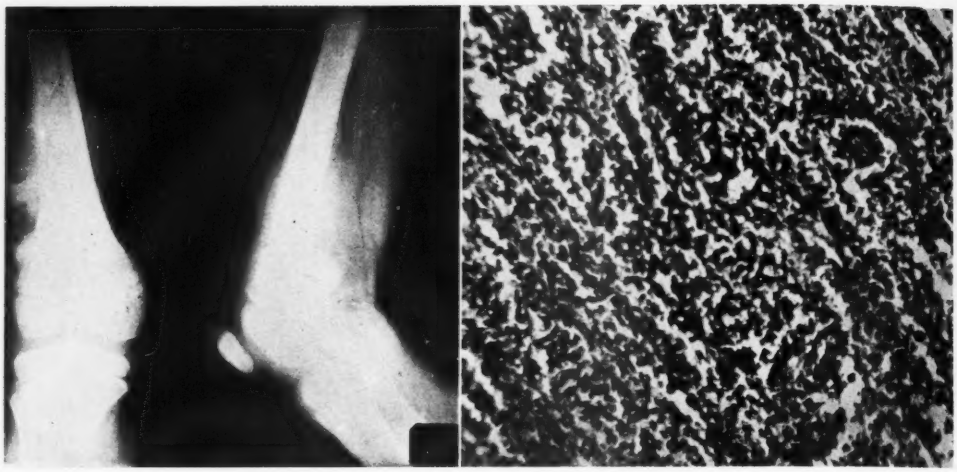


Fig. 9. Fig. 10.

Figs. 9 and 10. Case 5. W. B., male, aged 10 years (Reg. No. 68714). Osteogenic sarcoma, Grade IV.

tissue mass was shown, through which there were very faint, irregular bone deposits that were slightly more distinct on the outer aspect and posteriorly. There was no expansion of the shaft but definite destruction of the cancellous bone. These findings were regarded as typical of osteogenic sarcoma, probably arising in the periosteum. The location in the lower end of the tibia is rather rare.

Two days later, an amputation near the junction of the upper and middle thirds of the leg was performed, and the pathologist reported a fusiform osteogenic sarcoma of periosteal type, Grade II malignancy. The patient made an uneventful recovery and was subsequently given 200 K.V. roentgen radiation. Her progress was entirely satisfactory, and at the time of her last visit, seven months after operation, she felt well. She was wearing an artificial limb. There was no evidence of metastasis to be found in the glandular system or chest.

Three months later, a letter from her husband stated that one week after her last visit to the Clinic she developed a violent illness, with nausea and vomiting. After slight improvement, about the eighth day, she developed heart and kidney complications, and was taken to a Galveston hospital where she died within a few days of an acute uremia. No necropsy was done.

Case 2. T. R. C. (Reg. No. 75,476), aged 35 years, a dairyman by occupation and a World War veteran, entered the Clinic with the chief complaint of pain and swelling in the right forearm. While in action during the War, he had had two shrapnel wounds in the right forearm. He was told at the time that he had a greenstick fracture of the radius. Two years ago (1928), a small, hard, painless mass appeared on the radial side of the forearm near the wrist. This gradually became larger, and within one year became painful, and for the last eight months he had carried it in a sling. He had two radium treatments, administered during the months of June and November, 1929, in an army hospital.

In February, 1930, he entered our Clinic, and on examination the distal third of the right forearm was two to three times the normal size. The mass was solid, firm, and tender. The patient had little use of the hand and fingers, which showed considerable edema. X-ray examination of the forearm revealed a pathologic process involving the lower half of the radius, characterized by almost complete destruction

of the bone shaft, with considerable expansion of the cortex and rather scanty, irregular deposits of new bone throughout a soft tissue mass. There had been a fracture through the tumor, which was not healed. This case was regarded from the history, physical, and roentgenologic findings as one of osteogenic sarcoma, which was growing rapidly at this time. This growth in the lower end of the radius also represents one of rare location. An amputation was performed above the elbow, and a fixed section was reported by the pathologist as medullary and subperiosteal osteogenic sarcoma. A portion of the specimen was sent to Dr. W. B. Coley, of New York, who confirmed the diagnosis. The patient died at his home nine months later.

Case 3. Mr. L. G. M. (Reg. No. 78,895), aged 63 years, a farmer, registered at the Clinic on Aug. 18, 1930, with the chief complaint of soreness in the left foot. His present illness began the preceding Fall, when he noted some discomfort in his foot, which developed after he had been on his feet irrigating his farm. The foot began to swell, mostly on the anterior surface, but never became very large, nor did it get red or hot. When admitted, the patient was still able to walk and was fairly comfortable, but wished to be examined to determine the nature of the condition.

A tentative clinical diagnosis of arthritis was made, but after roentgen-ray examination this was changed. The roentgenogram showed bone changes in the anterior half of the astragalus, characterized by a sort of honey-comb appearance with rather dense bone structure, small cavities, and rather dense trabeculæ, and some expansion of the cortex and narrowing of the joint space between this and the navicular. A notation was made that a comparison with films made elsewhere from four to six weeks previously showed little or no change. The character and density of the tumor mass, the slight change in one month, and the lack of bone invasion into the soft tissues indicated a chondroma or giant-cell tumor. A biopsy was performed, and the pathologist reported chondroma with myxomatous regression. Amputation was done six days later, and final study of the pathologist confirmed the original diagnosis. The patient made an uneventful recovery and left the hospital in ten days, against the surgeon's advice. Like the two previous cases, the occurrence of malignant disease is rare in this location. This case also represents an example of malignant change in what was probably a benign lesion originally.

Case 4. Mr. S. H. R. (Reg. No. 72,931), aged 46 years, gave the chief complaint of pain and swelling of the left knee. A horse fell with this patient 34 years previously, injuring the left knee. Ever since that time the knee had been weak and at times painful. Six years before admission he had noticed a small lump, which seemed attached to the bone on the external posterior region of the knee. This gradually grew in size, with only slight discomfort, until four years before admission, when he began to have severe pain, extremely so at times. The mass had gradually increased until the knee had become involved in a large swelling and the joint practically fixed. The patient had been unable to walk, having been in bed for the past nine or ten months. For the past two or three months he had had pain and swelling in the left hip and groin. Until recently, he had been treated for rheumatism with massage and "magnetic" applications, as he called them, but he had grown worse. The pain increased until he became unconscious—the patient was in that condition when brought to the Clinic. There was a history of venereal infection twenty-five or thirty years previously, and his Wassermann at the time of admission was positive. Under a few weeks of anti-syphilitic treatment he seemed to improve, especially as to his mental condition.

A clinical diagnosis of sarcoma of the lower end of the femur was made, and the x-ray showed a large, soft tissue tumor about 15 cm. in diameter, principally on the posterior aspect. The medullary canal was apparently not involved. There was a

slight elevation of the periosteum, and an irregular deposit of new bone was noted throughout the soft tissue mass. There was no evidence of pulmonary metastasis, although there was some inguinal and femoral gland involvement. Because of the slow progress of the tumor without lung metastasis, amputation was advised and performed. The pathologic report was a periosteal chondrogenic sarcoma.

The patient made an uneventful recovery and returned for x-ray treatment in one month, three months, and again in ten months. At the latter visit, he had extensive metastasis in the lungs and did not return for further care.

Case 5. Master W. B. (Reg. No. 68,-714), aged 10 years, entered with the chief complaint of swelling in the right leg. For about a month his parents had noticed a swelling on the outer side of the lower third of the thigh, and had observed that he complained of a little pain. The swelling was noticeably increasing, as had been pain during the last two or three weeks. About two weeks previously, the patient had received a blow on the thigh, since which time the pain had been worse, especially when walking. Physical examination showed a hard smooth swelling about three inches in diameter on the lateral side of the lower third of the thigh. The overlying skin was movable but apparently attached to underlying tissues. The growth felt as if it arose from the bone and seemed to extend posteriorly into the popliteal fossa. X-ray examination showed a considerable number of right-angle radiating lines of bone deposit, especially on the exterior and posterior aspects of the femur, involving the lower five inches of the shaft. On the exterior and anterior aspects there was some erosion of the cortex, with complete destruction of the periosteum and of the medulla. This bone deposit was not confined, apparently invading the soft tissues, and was, therefore, considered to be of malignant nature. Some authors deny that right-angle radiating lines are characteristic of malignancy, claiming the deposit of bone may be in various forms and that there may be several varieties of arrangement of the new bone in the same case.

The clinical and roentgenologic evidences in this case pointed to osteogenic sarcoma. Amputation was performed at the junction of the upper and middle thirds of the thigh. The pathologic report was osteogenic sarcoma, sub-periosteal type, Grade IV malignancy. The patient left the hospital in good condition and did not return for further observation.

SUMMARY

Osteogenic sarcoma is a relatively rare disease. It occurs chiefly in young persons. It frequently follows trauma, which may be of a rather trivial nature. It is practically always associated with pain. The roentgen-ray appearance is the chief factor in diagnosis. The history and physical examination will often assist in the differential diagnosis. When doubt still exists, biopsy may be performed under certain conditions, though this is rarely satisfactory. The treatment should be early and radical, because the mortality rate is unusually high.

BIBLIOGRAPHY

(1) Broders, A. C., and Pemberton, J. de J.: Surg., Gynec. and Obst., 1934, **58,** 100.
(2) Campbell, Willis C.: Am. Jour. Surg., new series, **20.**
(3) Goodwin, W. H.: Arch. Surg., June, 1929, p. 2353.

BONE LESIONS IN CHILDREN[1]

By JOSEPH I. MITCHELL, M.D., *Memphis, Tennessee*

THE bones of the child differ from those of the adult skeleton in structure and composition, and, as a result of these variations, the osseous reaction to pathologic processes varies at different age periods. The bone of the child being more vascular is subject more frequently to infection of hematogenous origin and being less compact is more quickly destroyed by infection; also, being less compact than adult bone it will yield more readily under pressure or strain. On the other hand, the greater vascularity and the inherent power of growth and repair of young tissues result in rapid bone proliferation and, at times, complete restoration after injury or disease. Affections peculiar to the epiphyses may occur only during the period of growth; certain diseases of infancy and childhood affect the epiphyses primarily, retarding growth and producing deformities. Trauma is common in childhood and may be a predisposing or direct etiologic factor in many bone affections. Neoplasms of bone, both benign and malignant, are more prevalent during the early decades of life, while metastatic lesions in bone are rarely seen in childhood.

The value of the roentgen ray in diagnosis of bone lesions cannot be overestimated; however, as a means of differentiation, the roentgenogram alone is not always conclusive. Frequently, to one of experience, the roentgenogram is diagnostic, more often it is suggestive, but at times it may be misleading unless the findings are correlated with the clinical and other laboratory evidence. The roentgenologic findings in the more common bone lesions of children will be discussed.

Disturbances of Growth.—To review certain well-known facts, the growth centers, or epiphyses, are located at the extremities of the long bones. Growth of the epiphyses may be arrested temporarily by various diseases, this disturbance being manifested later by transverse lines of condensed bone which remain throughout life. The epiphyses are resistant to infection but, in acute inflammatory processes, the incident hyperemia may act as a stimulus to growth and cause the bone to increase in length; thus, following osteomyelitis, the affected bone may be longer than the one on the opposite side. More frequently the destructive process causes partial or complete arrest of growth, with shortening of the bone. Traumatic separation of an epiphysis may also cause premature ossification and resulting arrest of growth. After loss in continuity of bone there will be compensatory hypertrophy of all osseous tissue on which additional strain is placed. Thus, after loss of continuity of one of the bones of the forearm or leg, the adjacent bone will hypertrophy to compensate for the defective bone. Trauma may cause a local myositis ossificans, if particles of bone or periosteum are detached, and institute bone proliferation in the adjacent muscles.

PYOGENIC AND LOW-GRADE INFECTION

Osteomyelitis.—The primary focus in acute infectious osteomyelitis is usually in the cancellous bone, near the epiphysis, but at the onset there may be no osseous reaction that can be demonstrated by the roentgen ray. The roentgenogram is consequently of diagnostic value in the early stage only for excluding other pathologic processes. The first manifestation, observed two or three weeks after the onset, is proliferation of the periosteum about the infected area. Later the roentgenogram is of great value and shows destruction with loss in density in the affected portion of the bone. The degree of decalcification is

[1] Read before the Radiological Society of North America at the Twentieth Annual Meeting, in Memphis, Tenn., Dec. 3–7, 1934.

proportionate to the intensity of the hyperemia, and is most severe in the bone and the formation of the involucrum is apparent. The roentgenogram is char-

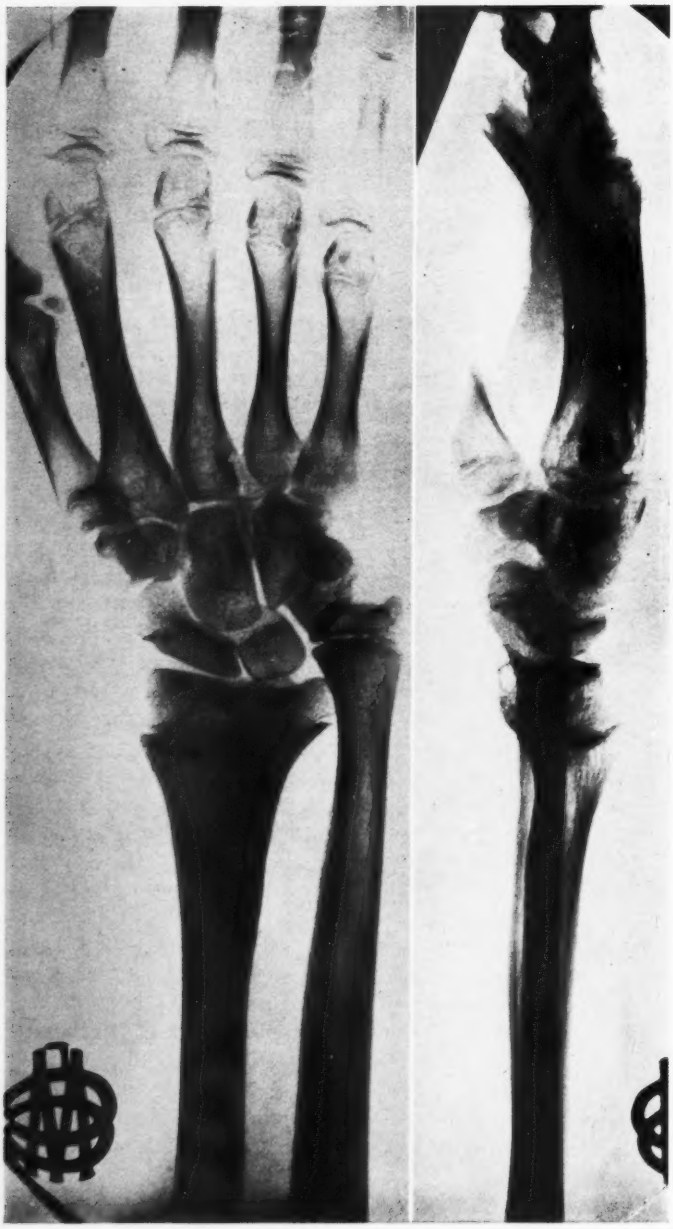


Fig. 1. Premature ossification of distal epiphysis of radius, with arrest of growth in a boy 14 years old. This followed traumatic separation of the epiphysis at the age of nine.

hyperemia of acute infection. The periosteum is separated from the shaft of the acteristic in the later stages when the sequestra have separated. A fact which

requires emphasis, owing to the importance of its clinical application, is that a fragment of bone completely cut off from the circulation so that it is avascular will retain its original calcium content, whatever changes may occur in the adjacent vascular bone. The sequestrum is dense and stands out in marked contrast to the surrounding atrophic bone. If, therefore, in the presence of generalized decalcification, one fragment of bone has retained its normal calcium content, the radiologist can say with certainty that the fragment is avascular and is therefore a sequestrum. After healing has taken place the bone is sclerosed and anemic; massive hypertrophy and increase in density are observed at this stage. The bone cortex may become so dense and hypertrophic that active processes, sequestra, or cavities within the interior may be obscured.

Osteomyelitis of Garré.—Chronic sclerosing osteomyelitis is a painful non-suppurative bone lesion found in children and adults. The tibia is most often involved and the roentgenogram shows a spindle-shaped enlargement in the shaft, well away from the epiphyses, a distinct thickening of the cortex, with a smooth periosteal covering, and a narrowing of the medullary cavity. It has been suggested that the pain is caused by the inability of the blood to circulate through the dense sclerotic bone. Relief may be secured by drilling multiple holes into the bone or removing a cortical window, but recurrence of symptoms is not infrequent.

Syphilis.—Syphilis affecting bones in children is, as a rule, of congenital origin and may be observed only in the tertiary stage. The diagnosis may be suggested by the roentgenogram and is confirmed in 90 per cent of the cases by a positive blood Wassermann reaction. In infancy, congenital syphilis is manifested usually as osteochondritis of the epiphyses. Multiple joint and bone changes are observed, with swelling of the joints and enlargement of the extremities of the long bones. The roentgenogram shows the articular cartilage to be intact; also, that all the pathologic changes are confined to the epiphyseal line and the bone directly behind it. There are present localized areas of softening and punched-out areas of destruction in the bone just beneath the periosteum at the point where the articular cartilage begins. There is no atrophy of

Fig. 2. Chronic osteomyelitis of humerus of 14 years' duration. A large sequestrum is present.

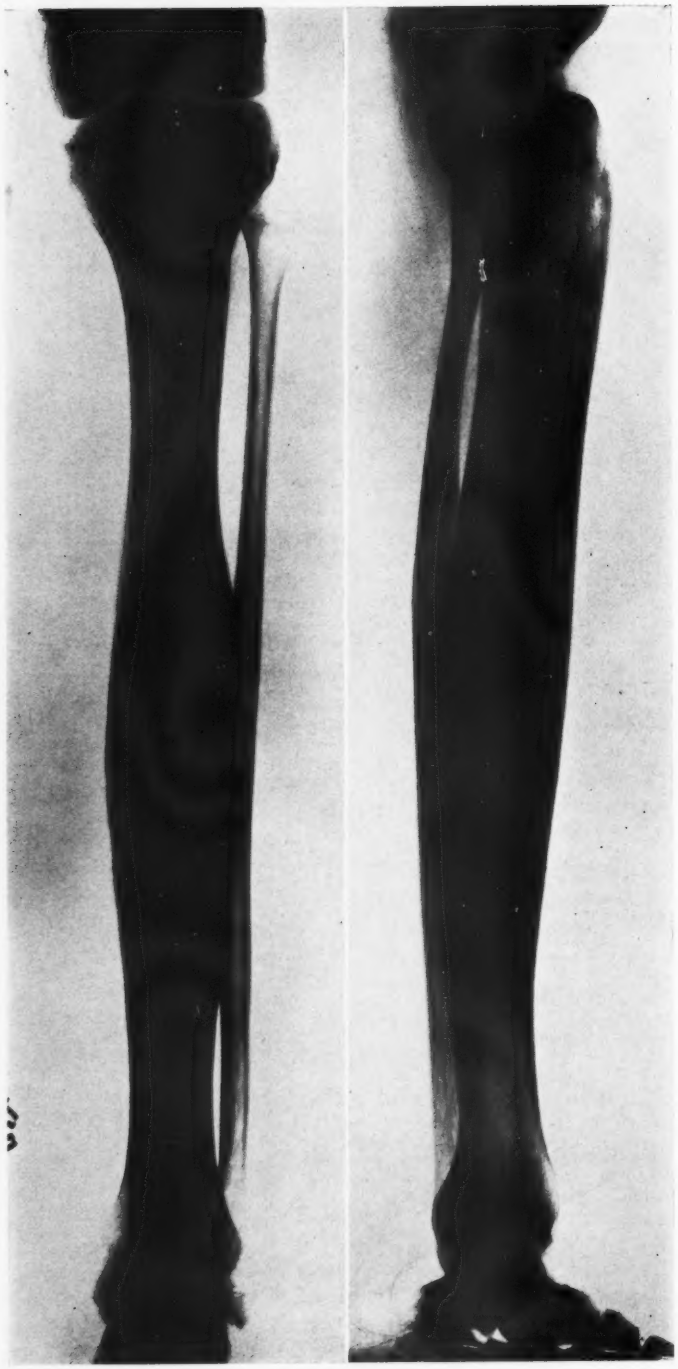


Fig. 3. Chronic non-suppurative osteis (osteomyelitis of Garré). Note the characteristic thickening of the bone cortex causing a spindle-shaped enlargement in the shaft of a long bone.

the bone but, on the contrary, there is frequently periosteal new bone production.

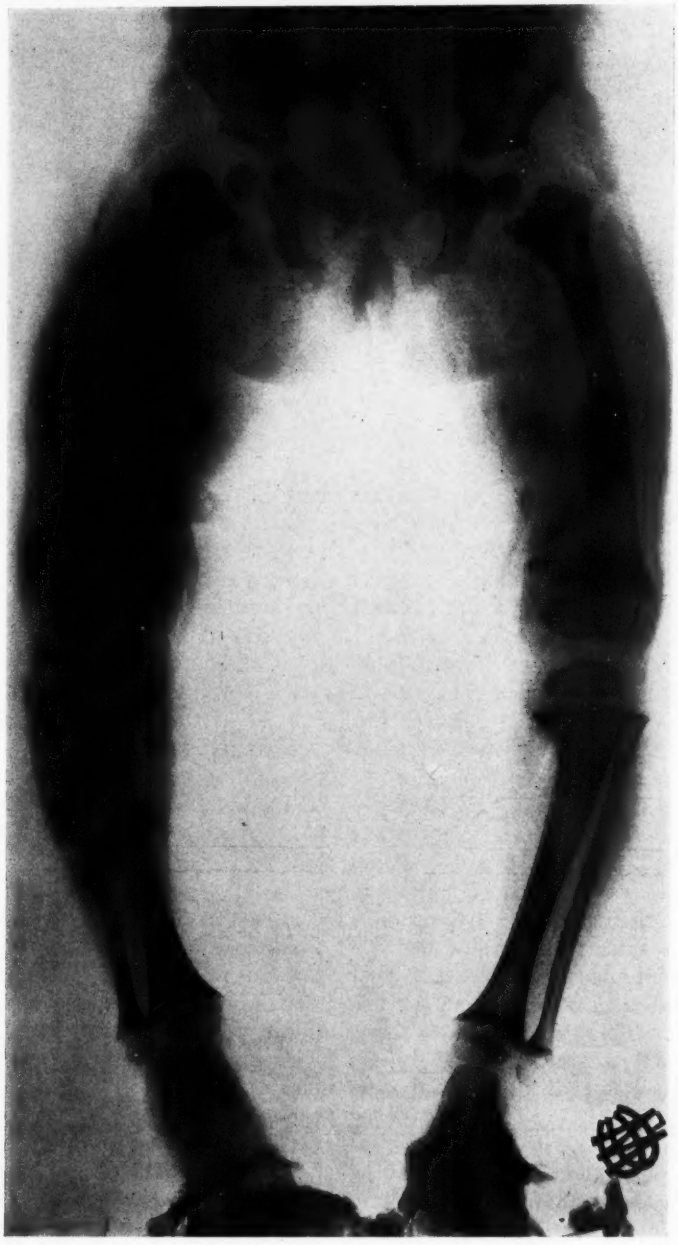


Fig. 4. Active rickets in a child two years of age.

On the whole, the calcium band shutting off the diaphysis runs regularly. In older children the syphilitic bone lesion may be either a condensing periostitis or osteomyelitis: in condensing osteitis or periostitis there is proliferation of bone along

the periosteal surface and thickening of the cortex, usually on the convex side of the shaft. The bone may be bowed, leading, leading to bony ankylosis, which, in the residual stage, serves to differentiate acute infectious arthritis from tuberculosis.

Fig. 5. Photograph of negro child aged five years, showing deformities resulting from multiple fractures in a patient with fragilitas ossium.

in the case of the tibia, to the condition known as "saber shin." The destructive form or syphilitic osteomyelitis is manifested by a combination of areas of destruction and bone proliferation.

Tuberculosis.—The pathologic process of bone tuberculosis begins most often in the metaphyseal region of the bone and extends to involve the entire joint. Joint tuberculosis is rare during infancy and is most common during the latter half of the first decade; it is usually monarticular, with increase of fluid and thickening of the peri-articular tissues. In the early stages the bones appear hazy and indistinct: after several months the articular surfaces become irregular and the underlying bone atrophic. As the articular cartilage and bone on both sides of the joint are destroyed the joint space becomes narrowed. Deformity and subluxation occur in untreated cases. There is little new bone production, and when ankylosis occurs with healing it is usually fibrous in character.

Acute Infectious Arthritis.—Pyogenic infection of a joint like tuberculosis is more often monarticular. The destructive process is more rapid than in tuberculosis; otherwise, during the acute stage the two conditions may be indistinguishable from the roentgenogram. As the disease subsides, there is marked new bone production

NUTRITIONAL DISTURBANCES

Rickets.—Rickets is a constitutional disease of infancy caused by an insufficient amount of Vitamin D and sunlight, and may be curable by the administration of these agencies. The lesions are multiple and symmetrical, and in the roentgenogram are seen to be confined to the epiphyseal lines. The newly developed bone does not reach full maturity and is composed of osteoid tissue resembling cartilage: this new tissue is softer than normal bone, and the epiphyseal area, which is broadened, tends to spread out. The diaphyseal band is irregularly waved once or twice, and the diaphyseal end of the shaft is broadened and depressed in the form of a saucer, this saucer-shaped expansion being more marked in the weight-bearing bones. The margins of the diaphysis are pointed. The shafts of the bones also become atrophic due to disturbed nutrition and to non-use. This rarefaction and softening lead to bending and distortion of the shaft; also, the bones are easily fractured. As healing takes place, the cortex of the curved bones becomes thickened along the concave surface of the shaft. Rachitic deformities, as changes in shape of the skull, thorax, spine, pelvis, bow legs or knock knees, may persist throughout the life of the individual.

Scurvy.—Infantile scurvy is caused by a deficiency of Vitamin C in infants who do

not obtain a sufficient amount of raw fruits and vegetables. The disease is characterized by multiple painful bone and joint

Fig. 6. Roentgenogram of left upper extremity of patient shown in Figure 5.

lesions. The signs by which scurvy may be manifest in the roentgenogram are as follows: (1) Irregularity, broadening, and condensation of the preparatory line of calcification, resulting in the formation of the "white line of scurvy," an intensely calcified band at the diaphyseal end of the shaft just proximal to the epiphyseal line. (2) There may be a small spur at the lateral margin of the diaphyses which usually points away from the joint. (3) A zone of rarefaction which represents lack of lime salt deposit. (4) A broad irregular edge of dense shadow in the epiphyseal center of ossification. (5) A rarefaction of the central portion of the center of ossification. (6) Separation of the epiphyses. (7) Atrophy of the bone, resulting in a ground-glass transparency of the shaft with clouding or obliteration of the trabecular structure and a thinning of the cortex to one-fifth of its normal width. (8) Evidence of hemorrhage into the soft tissues beneath the periosteum, and later calcification of the hematoma. (9) Subperiosteal fractures may occur in the ends of the diaphysis. All of the signs will probably not be found

in the roentgenogram of every case of scurvy but, according to McLean and McIntosh (9), increased density of the bearing. Shortly after puberty the bone structure improves and the frequency of fracture decreases.

Fig. 7. Roentgenogram of right lower extremity of patient shown in Figure 5.

zone of preparatory calcification, peripheral shadow of the center of ossification, together with blurring of the trabeculæ constitute sufficient evidence for a positive diagnosis.

CONGENITAL AND HEREDITARY DEFICIENCIES

Osteogenesis Imperfecta.—Increased fragility of the bones of children may occur congenitally in osteogenesis imperfecta (fragilitas ossium, osteopsathyrosis). The bones are fragile, and multiple fractures occur, usually in the shafts of the bones, and, at times, from very trivial injuries. The epiphyseal lines and centers of ossification are normal. The cortex of the shaft may be thinner than normal and in advanced cases this may be exaggerated from the atrophy of disuse. Firm union of the fractures with good callus is the rule, although there may be distortion of the skeleton as a result of angulation and bending of the softened bones from weight-

Osteosclerosis.—Generalized osteosclerosis is a rare bone lesion, beginning early in life. The condition, first described by Albers-Schönberg, is characterized by increased calcification of bone and fragility. The disease has been called "marble bone" but, as mentioned by Jones (7), this term is misleading. He suggests that the name "chalky bone" would be more accurate since, despite their apparent density, the bones are relatively soft, easily drilled, and liable to spontaneous fracture. In the long bones the cortex shows increased density and thickening, with encroachment upon and narrowing of the medullary canal. The ends of the shafts present an expanded appearance, with thinning of the cortex. The small bones such as vertebræ, tarsals, and carpals present a generalized increased density, with absence of bone structure. As yet, there being no recognized vitamin or endocrine disturbance, the cause of the abnormality is not known.

Dyschondroplasia.—This condition is characterized by multiple cartilaginous exostoses, and is also designated as hereditary deforming chondrodysplasia, hereditary multiple exostosis, multiple cancellous exostosis, diaphyseal aclasia, and ossified diathesis. The pathology consists of a disturbance of ossification of epiphyseal cartilage, resulting in the formation of multiple osteocartilaginous exotoses. The tumors are usually painless unless traumatized, and the symptoms are produced only by the mechanical presence of the growths and their interference with normal joint

Fig. 8. Juvenile kyphosis in a boy 17 years of age showing wedging of bodies of seventh to tenth dorsal vertebræ and irregularity of the secondary centers of ossification.

Fig. 9. Giant-cell tumor of femur. Note multilocular cystic tumor causing expansion and thinning of the bone cortex.

function. Obviously, removal of all the tumors is impossible, but, when necessary, those causing symptoms may be excised. After maturity, correction of osseous deformity may be indicated.

Enchondroma (Dyschondroplasia).—Enchondromas are benign bone lesions which may affect any of the bones formed in cartilage, and are characterized by the development of bone into osteoid tissue. The epiphyses may be involved, with retardation of growth of the affected bones. Fracture from slight trauma is common but the bones usually unite readily. No treatment has proved beneficial but the process subsides when full growth is attained. Retentive apparatus should be employed to prevent deformity.

Achondroplasia.—Achondroplasia is apparent at birth and is characterized by a disproportion between the shortened extremities and a trunk of normal length. In addition to dwarfism, there may be osseous deformity; also, the epiphyseal ends of the long bones are widened. The roentgenologic evidence consists of broadening of the epiphyseal lines and ossification of the epiphyses at an early age, leading to further interference in the growth of the bones.

EPIPHYSEAL AFFECTIONS

Certain of the intra-articular and extra-articular epiphyses may be involved in abnormal processes which present characteristic manifestations. The condition occurs most often in late childhood or near puberty; boys are more often affected than girls, and the affection may be confined to one epiphysis, or may involve two or more in succession, or simultaneously. The etiology is unknown but from the evidence available trauma is a prominent factor, and it is worthy of note that the lesions occur only in the weight-bearing areas of the spine and lower extremities.

Osteochondritis of the Scaphoid (Köhler's Disease).—Between the ages of three and six years, the scaphoid bone may be involved in a process which causes slight pain and a limp. The roentgenogram shows the bone to be flattened in the anteroposterior direction; the density of the bone is increased and the circumference is irregular.

Epiphysitis of the Tibial Tubercle (Schlatter-Osgood Disease).—This affection is observed more frequently in boys and is usually unilateral but may be bilateral. The roentgenogram shows proliferative and degenerative changes in the tibial tubercle, often with separation and fragmentation of the epiphysis which are diagnostic.

Coxa Plana (Legg-Calvé-Perthes Disease); Osteochondritis Deformans Juvenilis.—Coxa plana occurs in the latter half of the first decade and may be unilateral or bilateral. Legg (8) described two varieties, the "mushroom" and the "cap" types. In the mushroom type, the upper femoral epiphysis is rounded and flattened, while in the cap type, the head, though flattened, is not spread out. The roentgenogram shows that the epiphysis is crushed or flattened, with eburnation of the bone beneath the articular cartilage, and fragmentation. The epiphyseal line is wider than normal and irregular; the neck of the femur is broadened.

Coxa Vara of Adolescence.—Another hip affection is epiphyseal or adolescent coxa vara, which occurs more often in boys between the ages of twelve and fifteen years. The distribution is usually unilateral although both hips may be involved. Hypopituitarism, or other endocrine imbalance, is a predisposing cause, as the process more often occurs in obese children with Fröhlich's syndrome. The roentgenogram of an early case shows absorption along the epiphyseal line: later, the head slides downward on the neck of the femur, decreasing the angle between the neck and the shaft. If the position is not corrected, the head will unite to the neck well below its normal level and a permanent coxa vara will result.

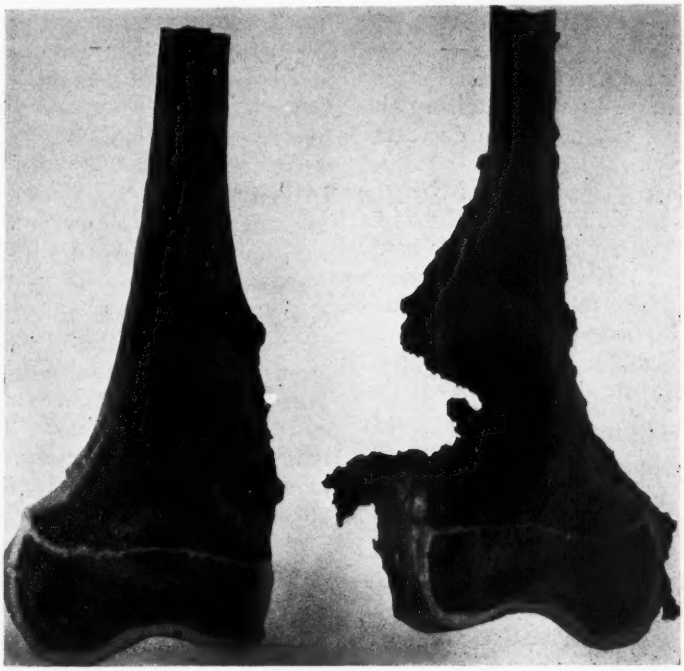


Fig. 10. Photograph of specimen after amputation. An osteogenic sarcoma of the femur in a boy 10 years old.

Vertebral Epiphysitis (Juvenile Kyphosis).—A definite disease entity causing dorsal kyphosis in adolescents has been described by Scheuermann (11). The bodies of the vertebræ from the seventh to the tenth dorsal are wedge-shaped, and

there are pathologic changes in the secondary epiphyseal centers of ossification. The upper and lower surfaces of the vertebræ are irregularly defined, this irregularity being especially marked at the anterior edge of the body, and the affected bones are atrophic. The disease, which is seen most often between the ages of fifteen and seventeen years, causes a fixed curvature of the spine.

Osteochondritis of the Vertebral Body.—Vertebral osteochondritis is analogous to epiphyseal disturbance in other bones during the period of growth; the disease occurs only during the first decade of life. The body of the vertebra is flattened and the opacity increased. The intervertebral discs are not involved.

ENDOCRINE DYSFUNCTION

Dysfunction of the endocrine glands may cause pathologic changes in bone. Stimulation of the pituitary gland produces an increase of growth and delay in ossification, particularly of the epiphyses of the long bones, and results in gigantism. Organotherapy is beneficial in the early stages but when the process is advanced, no treatment is of value.

Recently, it has been proved definitely that the parathyroid glands control the calcium-phosphorus balance of the body and that over-activity of the parathyroids causes absorption of calcium from the bones, with increase of calcium in the blood serum. The bones of the skeleton become cystic, producing the diffuse type of osteitis fibrosa cystica. Associated with the bone changes of hyperparathyroidism are other symptoms of muscular weakness; increased calcium in the blood serum; increased excretion of the calcium in the urine, and nephrolithiasis. Removal of the parathyroid adenoma arrests the disease process; the bone cysts are recalcified, the blood calcium returns to normal, and the other symptoms are relieved.

HODGKIN'S DISEASE

Skeletal involvement in Hodgkin's disease is more frequent than is generally realized and may precede the characteristic glandular enlargement. The principal change noted is a progressive fibrous tissue formation within the bone, associated with new bone production. Hyperplasia and degeneration of the bone marrow result in areas of altered density within the medullary portion of the bone and thinning of the bone cortex. Though less common, a generalized periostitis may appear in addition to the medullary involvement.

OSTEITIS FIBROSA CYSTICA

Osteitis fibrosa cystica is observed most often in the upper or lower extremities of the femur or humerus. The roentgenogram shows a central area of bone destruction, with thinning of the bone cortex: the cortex is rarely expanded. There are frequently no local symptoms, and the first manifestation may be fracture through the affected area caused by a slight injury.

NEOPLASMS

Benign Tumors.—Osteoma and osteochondroma are composed of bone and cartilage. In osteochondroma, the base of the tumor is composed of bone and the periphery is cartilaginous. The tumors occur near the epiphyseal ends of the long bones, and the process of growth is in an orderly manner, similar to mature bone. The roentgenogram demonstrates a circumscribed newgrowth, the periphery of which may be translucent and irregular while the stalk has the density of normal bone.

Giant-cell tumor is a destructive lesion, occurring usually in the epiphyseal region. The roentgenogram shows a central lesion which may expand the bone cortex: the cortex is also thinned and may be perforated. The interior of the cyst may be divided by bone trabeculæ into multilocular compartments, giving rise to the so-called soap-bubble appearance.

Malignant Tumors.—Osteogenic sarcoma occurs usually in the metaphyseal area. The tumor is not circumscribed but destroys the bone and invades the soft

tissues, while the original shaft of the bone may remain visible, passing through the newgrowth. The reaction of the periosteum where it is raised from the shaft produces lipping at the margins of the tumor. In the sclerosing type, new bone may be laid down without structure or in a ray-like manner perpendicular to the shaft, although this finding is not always demonstrable nor diagnostic when present. In the osteolytic type there may be extensive destruction without new bone production.

In Ewing's sarcoma, the roentgenogram shows extensive invasion and destruction of a large area of the bone, with expansion. When the tumor involves a long bone, the shaft may be surrounded by longitudinal strata of new bone deposited in successive layers. In the flat bones, as the ilium, the bone presents a mottled appearance. Malignant neoplasms of bone metastasize to the lungs and the prognosis is unfavorable, regardless of the treatment employed.

BIBLIOGRAPHY

(1) BAETJER, F. H.: Roentgenologic Signs of Joint Lesions in Children. Med. Clin. North Am., 1919, **2,** 1703.

(2) BLOUNT, W. P.: Hodgkin's Disease, an Orthopedic Problem. Jour. Bone and Joint Surg., 1929, **11,** 761.

(3) CAMPBELL, W. C.: A Text-book on Orthopedic Surgery. W. B. Saunders Co., 1930.

(4) IDEM: An Analysis of Bone and Joint Lesions of Known Syphilitic Origin. RADIOLOGY, 1925, **5,** 122.

(5) CONE, S. M.: Bone in Hodgkin's Disease. Jour. Bone and Joint Surg., 1927, **9,** 458.

(6) HENDERSON, M. S.: Chronic Sclerosing Osteitis. Jour. Am. Med. Assn., 1924, **82,** 945.

(7) JONES, R. WATSON: Calcification, Decalcification, and Ossification. British Jour. Surg., 1934, **21,** 461.

(8) LEGG, A. T.: The End-results of Coxa Plana. Jour. Bone and Joint Surg., 1927, **9,** 26.

(9) MCLEAN, S., and MCINTOSH, R.: Healing in Infantile Scurvy as Shown by X-ray. Am. Jour. Dis. Child., 1928, **36,** 875.

(10) MITCHELL, J. I.: Vertebral Osteochondritis. Arch. Surg., 1932, **25,** 544.

(11) SCHEUERMANN, H.: Kyphosis Dorsalis Juvenilis. Ztschr. f. orthop. Chir., 1921, **11,** Abst., Jour. Orthop. Surg., 1921, **3,** 715.

OSTEOGENIC SARCOMA: ITS PATHOLOGIC CHARACTERISTICS[1]

By CHARLES PHILLIPS, M.D., *Temple, Texas*

TO the roentgenologist, with his studies in differential tissue density, and to the pathologist, with his histopathologic studies, one of the very interesting developments of the present decade is the increasing importance and volume of work on one phase of neoplasia, that of primary malignant bone tumors. Their incidence is very low but their killing power high. Out of this has grown one typical illustration of the American genius for standardization, a registration system of co-operative voluntary study of bone tumors. Articles in foreign journals show the widespread value of this effort, and the establishment of similar registries for study of other tumors reflects American opinion of its worth and success. It is a matter of pride that your specialty and mine have so largely figured in this work. Let us keep at it with the hope that some day confusion of types and names may be replaced by order and simplicity.

The word "confusion" here is used deliberately, for even after a very long time there still exists a lack of agreement about the whole problem of the histogenesis of bone. There is general concurrence that the skeletal system is of mesodermal origin, and that the later mesenchyme lays down the cellular groundwork from which future separate structures develop. Probably, if we accept the pluripotential nature of these primitive cells, we shall not be surprised at what at times seems to be odd developments. These embryonic mesenchyme cells proceed as a rule in an orderly way, by little understood control mechanisms, to differentiate into various stages of pre-cartilage, cartilage, osteoid, and final bone by deposition of adequate mineral matter. Detailed studies describe special stages of these structures by names which are not given here. There is one term, however, "differentiation," which has of recent years come to be of great value. In general it denotes an orderly progress toward the normal in tissue development. Pathologists, of course, use the term constantly, but I note in reading that others are catching its significance. By potent and, as a rule, regular acting forces, cortical hard bone, cancellous bone, marrow with its valuable collection of cells, endosteum, periosteum, Haversian systems, osteoclasts, and osteoblasts come into being and relation. We wish at this time to acknowledge a legitimate difference of opinion. There is not complete agreement in regard to the origin and function of endosteum and periosteum as to bone production and particularly as to the origin of osteoblasts and osteoclasts. The Maximow (1) ideal of development of monocyte, histiocyte, and fibroblast shows close relationship of fibroblast to osteoblast. Carrel and Ebeling (2), and others (3), growing tissues in pure culture, show that monocytes, which are ordinarily thought of as blood cells, under some conditions differentiate into fibroblasts. Thus far, we see little result from attempted growth of bone *in vitro*, and so there is no agreement as to these details of histogenesis. Other studies (4) indicate the origin of osteoblasts from angioblastic tissue. Pathologists are more and more describing heterotopic bone formation in the body, and many firmly believe that under suitable conditions the fibroblast, type cell of ordinary connective tissue, may produce true bone completely away from periosteum.

Just as uncertainty exists in regard to the exact details of normal growth of bone, so we find it in studies on bone tumors. There is much evidence to substantiate the idea that in general bone production in a tumor of bone is a reparative attempt to produce intercellular substance, just as fibroblasts produce collagen in ordinary scar tissue.

[1] Presented before the Radiological Society of North America, at Memphis, Tenn., Dec., 3-7, 1934.

The detailed studies of Geschickter would lead one to believe that he thinks osteoblasts are bone builders. Brunschwig and Harmon (5) maintain that evidence for the osteoblasts is conclusive. Gruber (6), on the other hand, denies that the periosteum is the source of bony growth. In Europe, the so-called "humoral hypothesis" of osteogenesis is held by some. Brunschwig and Harmon (7), in a paper just published, discuss this and explain that under this theory the essentials are, proliferating connective tissue, edema, and a reservoir of super-saturation of calcium salts. These authors maintain that their experiments show the fallacy of the humoral hypothesis. Blaisdell (8) and Geddes (9) stand up for the osteogenetic power of periosteum. In the Registry of Bone Sarcomas, osteogenic sarcoma is separated from periosteal sarcoma, but I often wonder if separate divisions are necessary because we are dealing with primitive mesenchymal cells, which are pluripotent.

The increasing number of recorded cases of non-skeletal osteogenic sarcoma is in line with the foregoing statement. Gradually, classifications of tumors have undergone a change in line with newer conceptions of neoplasms not necessarily belonging entirely within one of the three primary germ layers. We allow, of course, for metaplasia, but I note a decrease in use of that term to explain unusual tumor cell mixtures. Osteogenic sarcoma is recorded as occurring in the thyroid of a dog (10), the lung (11), soft tissues (12), liver of the rat in experimental cysticercus disease (13), the kidney (14), the uterus (15 and 16), and the thyroid gland (17). These are among the notable examples. It is probably unwise to draw too many deductions from these facts, but they are at least in support of the idea that tumor cells from mesenchymal origin are capable of doing a variety of things.

Now let us turn our attention to the subject of the etiology of osteogenic sarcoma. All of us are aware of the great amount of work that has gone on and is going on now on cancer. We certainly do not know the cause, but we most assuredly do know some things today that yesterday were in cloud. Let us discuss briefly only two things, trauma and irradiation. Although the figures on the former still show such wide variations that it will be a matter of choice as to what you want to believe, it still is a matter of concern to us to think back on our own cases in which a definite trauma has preceded an osteosarcoma. I think the two are actively related. As to the effects of irradiation on tissues possibly being responsible for a bone sarcoma, we still must be conservative, although there is no longer doubt as to the cancerogenic nature of certain rays from an x-ray tube and from radium and radio-active substances. An editorial (18), on "Malignant Growths Following Irradiation," states that there are now on record 18 cases of sarcoma following irradiation treatment of joint tuberculosis in man. Animal experimentation supplements these figures with interesting data. The report of Martland (19), summarizing poisonings from radio-active substances, showed a mortality rate of 27 per cent for osteogenic sarcoma. Figures are accumulating to show that osteitis fibrosa and Paget's disease are important diseases contributing definitely to bone sarcoma.

The course of osteogenic sarcoma is so well known that here a brief résumé will suffice. So little is known of the actual happenings of the first stages of an osteosarcoma, that we can only surmise that the initial malignant stimulus is met by cellular increase in proportion to the nature of the agent and its activity, the age of the patient, the position of the lesion in the bone, the presence or absence of trauma, and that great unknown, the resistance of the patient. It may or may not be right to say that these cell changes are originally malignant and not purely benign and reactive. Be that as it may, we know that cell proliferation is active and soon invasive, with osteogenesis or osteolysis, or both. It has been shown experimentally (20) that when a growing tumor elevated the periosteum, new bone was produced, but as soon as the periosteum was broken

through and sarcoma cells invaded adjacent tissues there was no osteogenesis. The occurrence of giant cells in osteogenic sarcoma has been the source of much confusion. Geschickter and Copeland (21) have recently analyzed this subject in discussing metastasis of giant-cell tumors, and conclude that a true giant-cell tumor is benign and never metastasizes but that osteoclastic giant cells may be present in true osteogenic sarcoma, and give trouble to the pathologist who studies the tumor. Although this subject is technical, it may also concern the radiologist in shedding light from biopsy specimens on the nature of certain bone shadows. Let me point out again the difficulty of accurate classification of neoplasms by biopsy, in which usually only one area of a neoplasm is tapped.

There is another problem about the effects of osteogenic sarcoma on the body, and that concerns the location and nature of metastatic deposits. The first of these is well known to the roentgenologist. In the second it is interesting to find the lack of uniformity about pathologic slides of metastases. Do they or do they not form bone? Here again we get into technical details, but it will interest you to find such a lack of agreement among good students. There are, however, two points of common understanding. They are that metastasis may generally be expected unless the lesion was favorable and radically treated, and that these secondary colonies are radio-sensitive to a limited extent.

The pathologist of to-day who gets tumor tissue to study is partially responsible for treatment and results, with the surgeon and the radiologist, and so it may be well to see if we are getting anywhere. In general, figures are discouraging, but we believe that results are not all bad with those bone sarcomas, the cells of which produce much intercellular substance, as bone or fibrous tissue. To be able to tell this we must have tissue for study, and so the necessity for biopsies is urged. A carefully worked up, large series of cases like those of Geschickter (22) and those from the Registry point the way toward a better understanding of our problem in its radiologic and pathologic features. If all of us will register our cases for critical study, we may some day see a marked lowering of the present terrific mortality. The radiologist, pathologist, and surgeon are the team picked to win the game.

SUMMARY

It is seen that still much confusion exists as to the details of normal bone development, but that the cells of origin of osteogenic sarcoma are from primitive mesenchyme and capable of developing in several directions. Records of cases of heterotopic bone formation, and those of non-skeletal osteogenic sarcoma are accumulating to a degree of raising questions about the histogenetic relationship of all mesoblastic malignant neoplasms. The importance of effects of various forms of irradiation on the body, and of the more than casual relationship between osteosarcoma and osteitis fibrosa is emphasized.

BIBLIOGRAPHY

(1) MAXIMOW, A.: Physiol. Rev., 1926, **4,** 533, Idem: Proc. Soc. Exper. Biol. and Med., 1927, **24,** 570.
(2) CARREL, A., and EBELING, A. H.: Jour. Exper. Med., 1922, **36,** 365.
Idem: Jour. Exper. Med.,1926, **43,** 461.
(3) FISCHER, A.: Compt. rend. Soc. de biol., **92,** 109, 125.
(4) MOSCHOWITZ, E.: Bull. Johns Hopkins Hosp., 1926, **27,** 71.
(5) BRUNSCHWIG, A., and HARMON, P. H.: Surg., Gynec and Obst., December, 1933, **57,** 711.
(6) GRUBER, G. B.: Virchow's Arch. f. path. Anat., 1926, **260,** 457.
(7) BRUNSCHWIG, A., and HARMON, P. H.: Am. Jour. Cancer, October, 1934, **22,** 342.
(8) BLAISDELL, F. E.: Arch. Surg., 1925, **11,** 933.
(9) GEDDES, A. C.: Jour. Anat. and Physiol., 1912–1913, **47,** 159.
(10) FELDMAN, W. H., and FORD, F. A.: Am. Jour. Cancer, March, 1932, **16,** 377.
(11) GREENSPAN, E. B.: Am. Jour. Cancer, 1933, **18,** 603.
(12) RHOADS, C. P., and BLUMGART, H.: Am. Jour. Path., 1928, **4,** 363.
(13) BULLOCK, F. D., and CURTIS, M. R.: Jour. Cancer Res., 1928, **12,** 320.
(14) WEBER, F. P.: British Jour. Child. Dis., 1931, **28,** 136.
(15) MANN, W.: Virchow's Arch. f. path. Anat., 1929, **273,** 663.
(16) RANKIN, F. W., and BRODERS, A. C.: Am. Jour. Surg., 1931, **12,** 74.
(17) BRODERS, A. C., and PEMBERTON, J. DE J.: Surg., Gynec. and Obst., 1934, **58,** 100.
(18) Am. Jour. Cancer, 1933, **18,** 622.

(19) MARTLAND, H. S.: Am. Jour. Cancer, 1931, **15**, 2435.
(20) BRUNSCHWIG, A., and HARMON, P. H.: Arch. Path., 1933, **15**, 881.
(21) GESCHICKTER, C. F., and COPELAND, M. M.: Arch. Surg., May, 1930, **20**, 711.
(22) GESCHICKTER, C. F.: Arch. Surg., 1932, **24**, 602 and 798.

DISCUSSION OF SYMPOSIUM ON BONE TUMORS

DR. MAX KAHN (Baltimore): I wish to congratulate the essayists on the excellence of their papers. The subject of bone disease and bone tumors has been so widely covered in this symposium that I hardly know where to begin. I believe that the study of bone diseases and bone tumors should be a combined study by the roentgenologist, surgeon, orthopedist, and pathologist and should include a good history, physical examination, laboratory tests, and roentgenograms. The roentgenologist who sees the patient first should have a working knowledge of pathology. He should also know what to do in certain cases according to certain findings—whether the patient should receive irradiation, or whether he should be referred to a surgeon or an orthopedist. In the same manner, the surgeon or the orthopedist who sees the case first should also be informed as to the best plan of treatment, whether irradiation or surgery.

I have made a few notes of some of the more important diagnostic features of some of the tumors and bone diseases, for it is manifestly impossible in a short time to cover the entire subject.

Of the benign tumors, the exostoses may be single or multiple. They occur frequently near the end of long bones and they may have a pedicle or may be sessile. These tumors are easily recognized on the roentgenogram and, while usually benign, may in rare cases undergo malignant changes. These tumors may be found at any age but occur more frequently between the ages of ten and forty.

Chondromas or chondromyxomas are also benign and are found chiefly in the mall bones of the hands and feet, ribs, and ernum. They occur more frequently between the ages of fifteen and thirty-five. The tumor expands and has a translucent appearance on the roentgenogram. Usually it is single but there may be multiple tumors. In one case a father had a very large chondroma of the sternum for which he was irradiated by me at intervals for many years. His son, aged 17, also had a chondroma of one phalanx; so that the question of heredity enters into some of the tumors.

Bone cyst, which is a benign tumor, occurs more frequently in children and young adults. Pathologic fractures may occur and healing take place. When due to hyperparathyroidism there is demineralization and generalized fibrocystic disease of the skeleton. Blood calcium is elevated and blood phosphorus is lowered. Deep x-ray therapy of the parathyroid and cystic areas may produce an arrest of the disease and healing of the condition. Surgical removal of the parathyroid tumor may be necessary in some cases.

Giant-cell tumor is found usually at the epiphysis of long bones, chiefly in the lower end of the femur, upper end of the tibia, or lower end of the radius in relatively young adults, but it may occur up to the age of forty; after forty, it is rarely seen. In the roentgenogram we find a defect of varying size in the bone, more or less trabeculated, surrounded by a bony shell which may or may not be perforated. Roentgen therapy is very useful and may produce complete healing of the tumor.

Of the malignant tumors, the sclerosing osteogenic sarcoma is visualized on the roentgenogram as a dense radiating bone tumor involving the periosteum, usually of the long bones of youthful patients, although rarely the small bones may also be involved. This tumor may also involve the bones of an adult at any age but is more commonly found under the age of twenty-five. The periosteum may appear raised and the new bone may have a ray-like appearance. Histologically, the tumor contains many large osteoblasts and an irregular distribution of osteoid substance. This type of tumor is usually radioresistant. The osteolytic type of osteogenic sarcoma is

highly malignant. There is bone destruction without bone expansion and usually it involves the shaft of the long bones of young adults. This tumor does not commonly respond to irradiation, although that should be tried before amputation. Metastasis to the lungs frequently occurs.

Chondrosarcoma, also known as chondromyxosarcoma, is a periosteal osteogenic sarcoma containing cartilage and may arise secondarily through benign exostosis or benign chondroma. It may be primary, and in that case usually occurs at the site where the tendons are inserted into the bone. It is found between the ages of ten and thirty. In the roentgenogram it is faintly visible as a superiosteal shadow, which may contain a few spicules of bone. The cortex and medullary canal are usually not involved until late in the disease. In the secondary chondrosarcoma, the patient usually has been aware of the existence of an exostosis or chondroma. It commonly occurs after thirty-five years of age and this malignant tumor may be seen on the roentgenogram, destroying the outline of a pre-existing exostosis or chondroma.

Ewing's tumor commonly involves the tibia or femur, although it may involve any bone, usually up to the age of twenty but sometimes in older individuals. It commonly involves the shaft, never primarily the epiphysis, and may metastasize to other bones late in the disease. In the roentgenogram the shaft of the bone appears widened and there is an appearance of a parallel layer or layers of new bone raising the periosteum. Histologically, the tumor contains small round cells with dense nuclei and scanty cytoplasm, simulating somewhat a lymphosarcoma. Deep irradiation is useful and may produce an arrest and healing of the tumor.

Multiple myeloma is a tumor commonly found as a single punched-out area in a rib, vertebra, or the upper part of the femur in individuals from fifty to sixty years of age. The disease is progressive and in the course of time more areas of bone destruction are found. Bence-Jones bodies are present in the urine in a high percentage of cases. Deep irradiation over the punched-out areas may produce healing, and the life of the patient may be prolonged for a number of years.

Metastatic carcinoma of bone is so familiar to all that I do not want to dwell long on it, except to call attention to the value of deep irradiation. The life of some patients may be prolonged as much as five years by irradiation. This was the experience of one of our patients who was treated at intervals during this time over the involved areas. She was practically free from pain, obviating the use of narcotics, and lived in relative comfort.

Xanthoma, or the Schüller-Christian disease, discussed so ably by Dr. Smith[1] this morning, is not very common. It is a disease of childhood or young adulthood, chiefly involving the skull or long bones. As seen on the roentgenogram the lesion has a punched-out appearance not unlike that sometimes seen in Ewing's tumor. Microscopically, many types of cells may be found, particularly large phagocytes and a type of cell resembling the Dorothy Reed cells found in Hodgkin's disease. Sections may contain lymphoid tissue, large eosinophils and foam cells. Roentgen therapy is valuable and frequently heals the lesion.

I want to emphasize a point made by Dr. Mitchell on myositis ossificans. He had a slide showing a child with deposit of new bone in muscle tissue. I had a patient some years ago, a decorator who accidentally struck his shoulder. About three weeks after the accident I saw him. On the roentgenogram there was quite a deposit of new bone in the soft structures overlying the head and upper end of the humerus. The surgeon who referred the patient was not familiar with the rapid growth of new bone and was ready to go in and remove it. We cautioned him that it would recur very rapidly if he attempted to excise this new bone in the formative stage, and had him wait a month. It turned out to be a compensation case, the surgeon was insistent on operating and trying to get the patient well

[1] Dr. Lester A. Smith's paper was published in May, 1935, p. 521, which see.

quickly, and against our advice did go in and remove the new bone. Within six weeks there was more new bone reformed than original new bone he had removed and in a year malignant changes had taken place. A few months later metastasis to the lungs occurred; in other words, sarcoma developed and the patient died. Had the surgeon left the case alone, we believe the condition would have remained quiescent and the patient remained well. In certain cases it is well to know that surgery at the wrong time may do considerable harm.

DR. WILLIS C. CAMPBELL (Memphis): Dr. Smith has given us a most comprehensive discussion on those diseases (as Schüller-Christian's) in which xanthoma occurs. My experience is limited to this metabolic reaction as it occurs in xanthoma of joints, tendons, the ends of the fingers, and as associated with giant-cell tumor of bone. The cells in these tumors undergo xanthomatous changes, probably by some inherent biochemical phenomenon, and are not due to a general metabolic imbalance, as complete local removal effects a perfect cure in a high percentage of cases.

Primary bone tumors should be classified as follows: (1) osteogenic, those derived from some of the elements found in the evolutionary process of bone production; (2) non-osteogenic, tissues residing in bone as marrow cells and blood vessels which do not possess the power of producing bone or any deviation therefrom. Dr. Phillips says that undifferentiated connective tissue may produce bone and there is not much distinction from an embryologic standpoint. I do believe that, practically, we can usually make the distinction between osteogenic and non-osteogenic. The diagnosis in bone tumors is accomplished by (1) an accurate history, (2) physical examination, (3) roentgenogram, (4) biopsy, and (5) by x-ray therapy.

Ewing's tumor, or endothelial myeloma, is of sufficient frequency to warrant discussion on this occasion. Dr. Mitchell has mentioned this tumor. I have analyzed 17 cases as published recently in the "Journal of Bone and Joint Surgery." I believe that there are three distinct stages of Ewing's tumor as demonstrated by the roentgenogram. First, there may be only condensation or increased density in the shaft. The second stage shows the characteristic expansion of the shaft, with proliferation of the periosteum in so-called strata or layers, that is almost pathognomonic. The third stage shows complete disintegration, with marked lipping or elevation of the periosteum and bony outgrowth at the junction of the tumor with the apparently normal shaft.

In the case demonstrating the second stage an erroneous diagnosis of osteomyelitis was first made which could have been avoided if attention had been given to a complete history. In the case illustrating the third stage there was a complete local regression following x-ray treatment by Dr. Rutledge, of Shreveport, La. As Ewing's tumor is highly radiosensitive, this case also illustrates the value of x-ray therapy as a diagnostic measure. This case remained apparently cured for a period of four and one-half years, when death occurred from metastasis.

The case illustrating the first stage which received x-ray treatment and Coley toxins, is now living and well after five years. Coley and Meyerding each report a similar case, with the same form of treatment and the same excellent results. No positive conclusion can be made from such a small number of cases, yet these results are worthy of consideration as they were secured without the sacrifice of the limb.

Trauma as a causative agent is not always present but is quite definite in a case operated on yesterday. This man, aged 30 years, dropped a heavy weight on the instep of the right foot about three months previously. This was followed by immediate pain, swelling and disability that has continued to the present time. On examination three months ago there was a hard indurated swelling over the first metatarsal bone of the right foot which was thought to be an unusual reaction to trauma, as there was extensive bone atrophy or osteoporosis

throughout the bones of the foot and leg. A cast was applied which permitted weight-bearing. After two months there was some local improvement but the tumor persisted. Exploration was decided upon and an osteogenic sarcoma was found. The entire first metatarsal bone with the tumor was excised. As tumors of the metatarsal bones are usually not malignant, further consultation is being had before deciding on future treatment.

Biopsy is attended with very little danger and should be routinely made. The report of any case from the roentgenogram alone is not worthy of consideration as conclusive, scientific evidence. Unless the pathologist has had special training in this field, the report so obtained is without value.

Some progress has undoubtedly been made in recent years, as evidenced by the results. In our clinic there are 11 cases living following amputation and two others following excision, x-ray, and Coley toxins, as compared to no living cases about fifteen years ago. Malignant tumors of bone are an even more serious problem than other forms of cancer, but if the same effort is given to the eradication of pre-malignant conditions and early diagnosis as is given to cancer, it is conceivable that even better results may be attained and much progress made in the treatment of primary malignant bone tumors.

DR. M. L. PINDELL (Los Angeles): I would like to ask Dr. Mitchell and Dr. Campbell what percentage of their cases of osteogenic imperfecta they have found to be hereditary. Some authors think that heredity plays a big part, while others do not. How many cases have you studied?

DR. MITCHELL (closing): We have not had more than four or five. I have nothing to add except to answer the Doctor's question. Our cases have not given a definite family history of the disease in other members of the family—the preceding generations. The condition, however, is stated in the literature to be an hereditary one.

DR. CAMPBELL: May I answer that question? It is a type of case with the blue sclera which is hereditary. There are two types—those with the blue sclera and those that have not the blue sclera. I cannot recall that any of our cases have had the blue sclera, but that particular type is hereditary, while the other is not.

DR. LESTER A. SMITH (closing): The question was just now put to me as to whether or not pathologic fractures occur in any of these states of xanthomatosis. Such pathologic fractures do occur. They have been reported in both Gaucher's and Schüller-Christian's diseases as evidenced by a collapse of a vertebral body or by a fracture of a long bone.

A MODIFICATION OF THE RADIATION TREATMENT OF CARCINOMA OF THE STOMACH[1]

By IRA I. KAPLAN, B.S., M.D., *New York City*

Director, Radiation Therapy Department, Bellevue Hospital

CANCER of the stomach is the most frequently occurring malignancy in human beings (1), constituting 25 to 40 per cent of all cancers. In a review (2) of 1,000 cancer cases referred during 1931–1932 to the New York City Cancer Hospital, approximately 9 per cent were cancer of the stomach; this number was exceeded only by that of cervix and breast cancers. Unfortunately, in only about 10 per cent of all stomach cancer cases is the disease recognized in the early stages.

A study of 37 cases of stomach malignancy autopsied at the New York City Cancer Hospital during 1929–1934 disclosed that in nine cases only was any form of operation possible before death, the others showing markedly advanced gastric lesions already present at the time the patients came to the Cancer Hospital.

The futility of the usual efforts to relieve cancer in stomach conditions, especially in advanced stages, prompted us to attempt a new form of therapy. By the use of radiation we are enabled to transform a totally hopeless condition into one in which some measure of aid can be given, the patient's suffering being alleviated and his life prolonged, with at least some degree of comfort. Hitherto in cases of hopeless involved carcinoma of the stomach, therapy of one form or another has consisted in giving sufficient opiates to relieve the severity of the pain. The surgical mortality in the more advanced cases is extremely high, and the results, even in those seen early, are by no means encouraging (3, 4, and 5). By itself, roentgen-ray radiation through the intact abdominal wall has offered not more than moderate palliative relief in some cases (6 and 7).

With the idea, therefore, of doing something more direct in the radiation attack on this lesion, we endeavored first to radiate the lesion directly with the x-rays, which has been attempted by others (8 and 9). For this purpose a method combining surgery and x-ray therapy was planned. The patient was prepared as is customary for surgical operation; a preliminary jejunostomy was done, the stomach drawn into the abdominal wound, and high voltage x-rays projected directly through a lead glass cone on the lesion.

The factors used in this method of irradiation were 200 K.V., 4 ma., 50 cm. distance, 6 cm. portal, filtration 0.5 mm. copper and 1 mm. aluminum, 100 per cent dose being administered at one time.

In four cases treated by this method, only one recovered sufficiently to move about; one succumbed the day following treatment, the second after an interval of a month, and the third after three months. For a time no further attempts were made with this method of treatment.

Direct irradiation of carcinoma of the stomach with radium has already been used with various degrees of success (10 and 11). Applications to the lesion have also been effected by introducing radium tubes into the stomach, various ingenious devices being employed in these efforts to apply the radium directly to the newgrowth. In a number of instances radium packs (12) were applied to the abdominal wall. Some workers attempted direct apposition of radium plaques through surgical openings in the stomach, but none of these were altogether successful, probably because they

[1] Because of changes in the organization of the service, further work along these lines was not carried out. However, since subsequent experience over the past several years has produced no improvement in treating stomach cancer by other standard methods that have been tried, we deem it not inadvisable to revive this method of irradiation. The following paper was prepared for publication in 1928, but even to-day, the plan as then devised and with certain modifications, is still applicable. This work was carried out in conjunction with Dr. Robert P. Wadhams, of the Third Surgical Division, Bellevue Hospital.

attacked the tumor lesion extra-murally and delivered a large dose of irradiation over a short period of time.

Fig. 1. Case 1.

Fig. 2. Case 2.

With the advent of a better technic in the use of radium emanation, that is, the use of filtered seeds in more or less inaccessible lesions heretofore not treated by radium puncture, we believed we had found, perhaps, a feasible method of attacking those malignancies of the stomach which before had not been amenable to treatment.

This method, employed in conjunction with surgery, alleviates the immediate distress in these cases and slowly attacks the malignancy itself. With this procedure, too, there is the possibility that a lesion, previously thought inoperable, will become so reduced in size that surgical intervention for removal of the primary lesion may be considered.

The technic is not at all complicated, and consists of a preliminary gastro-enterostomy, followed by the delivery of the stomach into the abdominal wound, localization of the lesion, and implantation therein of suitably prepared, filtered radon seeds. The number of seeds and the strength of the radon in each varies with the extent of the lesion. In the three cases herewith reported, from 20 to 40 gold seeds were used, containing approximately 1 millicurie of radon in each seed. The seeds were implanted in the part of the stomach wall involved by the tumor, and were placed in parallel lines up to, but not puncturing through, the mucosa of the stomach. Seeds were also placed in all palpable accessible lymph nodes located in the vicinity of the stomach. The gold filtration of 0.3 mm. absorbs approximately 95 per cent of the beta rays, thereby to a large extent avoiding localized necrosis. Following the radon implantation, the abdominal wound is closed in the usual surgical manner. The next day the patient may be put on a nourishing soft diet, and in a short time allowed up and about.

A few days following the healing of the abdominal wound, high voltage x-rays are directed to the stomach lesion, anteriorly and posteriorly through the abdominal

wall. In this way additional radiation over a more extensive area is delivered to the tumor and surrounding tissues.

In carcinoma of the stomach, the pylorus is the most frequent site of the lesion. Of the three cases herewith reported, two were pyloric tumors, and the third involved nearly the entire stomach, presenting the so-called "leather-bottle type." The result in two cases was good, and bad in the third. The two patients were alive and comfortable, one five months and one after two years: the third patient, with the leather-bottle type stomach, died two months after treatment, having been bed-ridden continuously following treatment.

CASE REPORTS

Case 1. Mr. W. B., aged 61 years, single, a German farmhand, was admitted on July 26, 1927, complaining of a pain across his abdomen, dizzy spells, and black spots before his eyes. His family history revealed that his mother had died of old age; his father had died of tuberculosis, and one brother had died at the age of 30, cause unknown. The patient himself had a chancre at 18 years of age. Gonorrhea twice, about 42 years ago. Wassermann was negative. He had been in good health until July 5, 1927, when he experienced dizzy spells, with black spots before the eyes and pain across the abdomen on the first day. Stools from onset were watery. For four days before admission to the hospital, he would awake at night with profuse watery vinegar-like vomitus; he had none during the day.

A gastro-intestinal series showed carcinoma of the pars pyloris. Two-thirds of the meal remained as residue after six hours. On examination, a definite hard irregular mass was felt on expansion to the right of the median line, and about 10 centimeters below the xiphoid. Free HCl, 0: lactic acid, positive.

On Aug. 22, 1927, the patient was given a 55 c.c. blood transfusion. On Aug. 23, 1927, he was taken to the operating room where a gastro-enterostomy was done, and

Fig. 3. Case 2. Postmortem stomach, the x-ray showing radon seeds in wall.

radium was implanted (15 gold seeds, 21.20 millicuries). A gland was removed and the pathologic report showed metastatic ademocarcinoma. Following operation, the patient did well and was up and about after one week. Pain and vomiting were relieved. He has been coming regularly for x-ray treatment.

On Nov. 19, 1929, he reported to the hospital in fair condition, with some gastric distress. He has not reported since then. (The patient has been alive and in fair condition for nearly two years.)

Case 2. Mr. J. R., aged 62 years, a widower, was admitted on Aug. 31, 1927, complaining of a pain in the left abdomen. His family and past histories were negative. The onset of symptoms began three months ago, with pain in the left upper abdomen, which increased steadily and was aggra-

vated by food. He had not taken solid food for three months.

On Aug. 23, 1927, an x-ray examination showed the stomach markedly diminished in size, with complete absence of peristalsis of both lesser and greater curvatures of the pars cardia and media. The diagnosis was diffuse cancer of the stomach.

Physical examination showed an irregular hard tender mass, 2 × 1 in., in the epigastrium just under the costal margin on the left. Wassermann was negative. Gastric analysis: blood, positive. No free HCl; lactic acid, positive.

On Aug. 31, 1927, an operation under general anesthesia was performed, a jejunostomy, followed by radon (40 seeds implanted, gold filtered, 1 millicurie each). A pathologic report of the gland removed was metastatic carcinoma. The subsequent history revealed that the patient did poorly following operation and remained bed-ridden until the time of death, which occurred Nov. 3, 1927.

Postmortem examination showed the stomach to be hard, leathery, nodular, nonflexible, and to cut with difficulty. The mucous lining was completely replaced by fibrous tissue (Fig. 3). No necrosis.

Case 3. Mr. G. A., aged 30 years, a white, Russian cook, was admitted Sept. 19, 1927, complaining of vomiting and inability to retain food. His family history was negative. The patient had had measles in childhood; no adult illness.

At the time of admission the patient was emaciated, having lost 22 pounds in the three months since the onset. He had substernal pain following the taking of each meal, relieved upon vomiting food from 13 to 20 hours afterward; there never was any blood in the vomitus. He had had cough and dyspnea since the onset of the condition, but no difficulty in swallowing. The pylorus was irregular.

A gastro-intestinal series revealed that at the end of six hours three-fourths of the meal remained as residue. A diagnosis of organic pyloric obstruction was made. Physical examination showed that there was no visible or palpable mass in the abdomen. The patient looked years older than his actual age. Vomitus was never projectile, never bloody, but coffee-colored. Stools were normal in color. Wassermann was negative. Gastric analysis: blood, positive. Free HCl; lactic acid, positive.

On Oct. 19, 1927, under general anesthesia, a post-gastro-enterostomy was done and 32 gold-filtered seeds of radon implanted in the wall of the stomach in and around the tumor mass. The patient returned to the ward in good condition. Following treatment, he was markedly relieved of most of his symptoms, but still had some pain. In two weeks he was up and about the ward, and was reporting regularly for x-ray treatment.

In February, 1928, the patient began to do poorly and died on March 2, 1928, from cachexia. (He had been alive and well for five months.)

55 East 86th Street

BIBLIOGRAPHY

(1) EWING, JAMES: Neoplastic Diseases. W. B. Saunders & Co., 1922. (Gives the statistics and occurrence and describes the pathology of gastric malignancy.)

(2) KAPLAN, IRA I.: Report of Over 1,000 Unselected Cancer Cases Treated, 1931–1932. RADIOLOGY, June, 1933, **20**, 433–449.

(3) PATTERSON, H. J.: Cancer. William Wood & Co., 1925.

(4) PERSSON, M.: Abstracted in Jour. Am. Med., Assn. 1927, **89**, 1720.

(5) ST. JOHN, F. B.: Ann. Surg., August, 1927, **86**. (Describes the results of surgical interference in carcinoma of the stomach.)

(6) SEITZ and WINTZ: Unsere Methode der Röntgen Tifan Therapie. Urban & Schwarzenberg, 1920. (Roentgen treatment of stomach malignancies.)

(7) EVANS and LEUCUTIA: Am. Jour. Roentgenol. and Rad. Ther., 1923, **10**. (Results of deep roentgen treatment of gastro-intestinal malignancies: 25 cases so treated, with good palliative results.)

(8) SOLOMON, ISER: Precis de Radiotherapie. Masson, Paris, 1926. (Finsterer's direct radiation treatment of exposed malignant stomach.)

(9) WERNER, R.: Lehrbuch der Strahlentherapie. Urban & Schwarzenberg, 1925. (Method of exposing carcinomatous stomach, delivered through section of abdominal wall, to high voltage x-rays.)

(10) EWING, JAMES: Mutter Lecture. Published in Report of the Memorial Hospital, Hoeber, 1923. (Direct implantation of radium into the gastric tumor.)

(11) MENEES, THOMAS O.: Am. Jour. Roentgenol. and Rad. Ther., 1924, **11**, and Jour. Am. Med. Assn., 1926, **86**. (Devised an ingenious device for applying radium directly intragastrically to the lesion.)

(12) PINCH, A. E. HAYWARD: A Clinical Index of Radium Therapy. Published by the Radium Institute, London, 1926. (Method of radium therapy through the abdominal wall with external radium packs.)

PRELIMINARY OR PRE-OPERATIVE AND PRE-RADIUM IRRADIATION IN THE MANAGEMENT OF MALIGNANT DISEASES[1]

By J. THOMPSON STEVENS, M.D., *New York City and Montclair, N. J.*

BLOODGOOD (1) states: "My most recent experience convinces me that one should think of using irradiation with x-ray or radium before rather than after operation. It must be given a thorough trial. At the present time the majority of authorities, I think, take too little time in pre-operative irradiation. Properly done, it does not interfere with healing. I have not had any interference with healing after operation when there has been pre-operative irradiation to the breast." It is felt that you will agree that here is certainly food for thought. Can it be that those of us who have advised pre-operative and pre-radium irradiation in the management of malignancies, from the earliest days, are actually going to live to see it adopted by our foremost neoplasticians? Bloodgood's unique position as a master surgeon and a surgical pathologist of international reputation, with many years of service in a great medical institution, especially qualifies him to speak with the utmost authority, because he has had an almost unlimited experience in the management of malignant neoplasms by all of the accepted procedures known today. Therefore, anyone who treats malignant diseases should, without further delay, at least acquaint himself with the data that are accumulating in medical literature favoring pre-operative and pre-radium irradiation.

Ewing (2) states: "In general, radiated cancer tissue shows degeneration, necrosis, and atrophy of tumor cells, followed by cicatrization. This process is marked by peculiar swelling, liquefaction of cell cytoplasm, swelling, and hyperchromatism of cell nuclei, followed by disintegration of the cells. It is usually attended by marked hyperemia and lymphocytic or leukocytic or plasma cell exudate. The effects are produced partly by action on the tumor cells, and probably more by action on the blood vessels. The acute degenerative stage is followed by various types of cicatrization. In imperfectly radiated tissue, some tumor cells often persist in a condition known as abortive fibrosis, from which recurrences may develop. All stages of partial or complete destruction of tumor cells are commonly found at various stages of radiation reaction, and the progress of events varies greatly, depending on the strength of the dosage. The very numerous important details of the process of radiation reaction cover an extensive field, upon which there is voluminous literature." In other words, *properly* irradiated malignant cells are devitalized. Such devitalized cells will not grow or produce metastatic newgrowths when transplanted by the manipulation which always accompanies any operative procedure; or when radiation doses are too small to completely destroy their cells, their vitality is so depressed that recurrence and metastatic lesions appear with lessened rapidity, *i.e.*, they have difficulty in reproducing themselves. Cowell and Russ, in Radium and X-rays and the Living Cell, record their experiments which prove that all of the effects just mentioned are not fancy but actual fact.

Pfahler (3), more than twelve years ago, published a paper which dealt with the problem of preliminary or pre-operative irradiation. This was one of the earliest papers advising such treatment, and it is here that the details of this method of treatment were laid down, many of which are being adopted or are being followed by our foremost neoplastic clinics throughout the world. Pfahler was probably the first to use and advise this preliminary irradiation, and at that time described it under "ante-operative" irradiation. In Pfahler's hands,

[1] Presented before the Radiological Society of North America, at the Twentieth Annual Meeting, at Memphis, Tenn., Dec. 3–7, 1934.

preliminary irradiation had a more or less thorough trial prior to the appearance of the above paper for, as he says therein, "Therefore, since those clinical observations and experimental investigations show a devitalizing effect upon malignant cells, we are justified in recommending that the rays be used for this purpose preceding operation, as I have been doing for a number of years."

For a number of years your essayist has stressed the value of pre-operative and pre-radium irradiation, and in several definite papers has included data showing that this plan of management is of greater palliative and curative value than is follow-up radiotherapy. None of this material will be reviewed here for obvious reasons, but at the end of this paper several references are added, thus making it easy for anyone who may be interested to look it up.

When a patient presents himself for examination with a tumor in which a surgical operation would seem advisable, let none of us ever be guilty of withholding that operation, but in the light of present-day knowledge, each of us should insist upon thorough preliminary irradiation, not only of the actual newgrowth but of the various regions in the immediate neighborhood. Whenever possible, insist upon this preliminary irradiation, even when the mass seems absolutely localized and there is no evidence of metastasis either locally or generally. Given a patient in whom operation seems contraindicated, preliminary irradiation would seem indicated before localized efforts are made to eradicate the disease by radium. Certainly radium implantation into a mass of viable cancer cells would seem as likely as operative procedures to produce mechanical metastasis, for while radium is being placed within the mass, the tumor must be held, squeezed, manipulated, and in all ways traumatized. Probably the most important reason for having such faith in preliminary irradiation is the fact that in the vast majority of patients who present themselves for advice and treatment, one can be reasonably sure of the exact location of all of the malignant cells, *i.e.*, within the tumor. Treatment at this time, then, irradiates *all* of the disease, whereas, after operation or radium implantation, no one can ever be sure of the exact location of all of the disease, except that it is distributed somewhere within the patient's body. The higher percentage of recurrences and often distant metastatic lesions which follow in cases not having preliminary irradiation, would seem to prove these statements.

Preliminary irradiation does not affect the general condition of the patient adversely, so that treatment may be given with no fear of increasing the hazard of subsequent procedures.

Because of the adaptability of the roentgen rays, they are generally used exclusively for preliminary irradiation. The focus-skin distance, filter, voltage, number of ports of entry, and dosage must, of course, be varied to meet the physical conditions indicated by the location of the disease, whether it is at or near the surface of the body, as in carcinoma of the breast, or in the depths, as in carcinoma of the uterine cervix and urinary bladder. The preliminary roentgen treatments are so planned that they will be completed within two weeks' time, with not more than from eight to ten days actually consumed in the treatments. Generally, in this two weeks of preliminary roentgen treatment, each port of entry is treated twice. With such a scheme of division of dosage, it is perfectly safe to allow the total preliminary roentgen-ray dosage to be increased by 50 per cent to each port of entry, *i.e.*, give to each port of entry 75 per cent of the maximum safe dose twice within two weeks, thus bringing the total dosage even up to 150 per cent to each port of entry.

Clinically, in the early cases of malignant tumors of the breast, while the disease is still localized to a single primary mass within the breast, radiation reactions are not always typical. Sometimes a distinct reduction in the size of the mass is noted during the two weeks of preliminary irradiation, but more often the reaction is characterized by some swelling of the entire gland, together with softening and some

slight swelling of the tumor itself. When there is hypertrophy of the glands in the axilla, a definite decrease in size of these metastatic lesions is to be expected to accompany preliminary irradiation, and when the breast is broken down, these glands will occasionally disappear entirely. In cases in which the glands do disappear completely during preliminary irradiation, it may be concluded that they were inflammatory in origin rather than malignant metastases. In cases characterized by fixation of the tumor and the breast to the chest wall, or fixation of the tumor to the overlying skin, or both, preliminary irradiation will sometimes change the entire clinical picture, and if the tumor happens to fall into the radiosensitive groups, the tumor may become more or less movable within its bed, *i.e.*, the disease is becoming localized. In cases in which pain is a prominent symptom, it diminishes and sometimes disappears entirely.

Often even in the most desperate cases of carcinoma of the uterine cervix, there is a marked change in the clinical condition of the patient. She is generally happier and has a more optimistic outlook, because usually the hemorrhages have disappeared; sometimes, even, there is no bloody streaking, discharge has decreased, and not infrequently all pain has disappeared. Conditions, in general, are almost always much improved and the patient comes up for local treatment not later than one week following the last day of the preliminary roentgen treatment.

Examination often shows an improved local condition even at this early date; cases that have had the most evidence of infection associated with the malignancy showing the most striking results. Not infrequently a new growth that appeared to involve the cervix, with extensions to other parts, has receded so that only the cervix is actually involved. The malignant extensions of the disease would seem not to have been actual, in such an instance, but proved to be only the products of an extensive pelvic infection grafted onto the malignancy. The malignant tissue itself may also show the effect of the treatments in that it may not bleed so easily. The field can be kept comparatively free from blood, and under such conditions a more accurate and efficient local radium treatment can be carried out by the operator.

In cases of carcinoma of the urinary bladder, frequently following preliminary roentgen irradiation, there is a marked improvement in the patient's general condition, especially in cases suffering with severe hemorrhage and secondary infection. Bleeding is controlled, often within twenty-four hours after treatment is begun. Aside from the benefit that the patient experiences from this alone, there is the fact that further cystoscopic studies can be made much more valuable because the vision of the examiner is not clouded with blood, and he is, therefore, able better to define the extent of the involvement. Urinary sediment, pus cells, and debris, *i.e.*, products of chronic infection, lessen and in some cases entirely disappear. Because of this the temperature is lowered and will sometimes reach normal within a few days, or before preliminary treatment is completed. In a considerable percentage of cases there will appear multiple implantations in the wall of the bladder following operation. Preliminary irradiation reduces these to a minimum, because irradiated cancer cells either do not grow at all when transplanted or grow with difficulty. Furthermore, while giving these treatments, sufficient time passes to permit of careful study and treatment of the patient's other vital organs; it is felt, therefore, that no valuable time has been lost or wasted because of this preliminary or pre-operative roentgen irradiation.

In conclusion, too frequently advanced and hopeless cases are the only ones given the benefit of irradiation. While these cases are often given excellent palliation, and occasionally a case of this type will survive for five years and longer, however, in these groups one must be prepared to accept ultimate failure in the vast majority of instances. Because of these facts, it is felt that the cases of malignancy presenting

themselves with the primary tumor should be given more complete and thorough treatment than is the rule to-day, because these are the cases that are going to give the majority of good end-results. Therefore, in these early cases, even though the disease is only manifested by a primary single tumor, let us encourage pre-operative and pre-radium irradiation. If the tumor proves to be benign, histologically, no harm has been done by the preliminary irradiation, and no post-operative irradiation is indicated. But should the tumor prove malignant upon histologic examination, treatment should be completed with thorough, skillful post-operative irradiation.

REFERENCES

(1) BLOODGOOD, JOSEPH COLT: Personal communication. Oct. 22, 1934.

IDEM: When should Irradiation with Radium or X-ray Preceed Operation or be Employed without Operation? Ann. Surg., November, 1932.

IDEM: Further Experience as to the Value of Preoperative Irradiation with X-rays or Radium and with Pre- and Post-biopsy Irradiation while Submitting the Sections to a Number of Experienced Surgical Pathologists. RADIOLOGY, June, 1934, **22,** 651–656.

(2) EWING, JAMES: Personal communication, Oct. 22, 1934.

IDEM: Tissue Reaction to Radiation. Caldwell Lecture, 1925. Am. Jour. Roentgenol. and Rad. Ther., February, 1926.

(3) PFAHLER, GEORGE E.: Radiotherapy in Cancer of the Breast. Surg., Gynec. and Obst., August, 1922, pp. 217–226.

(4) STEVENS, J. THOMPSON: Modern Methods in Treatment of Carcinoma of the Breast. RADIOLOGY, March, 1924, **2,** 156–159.

IDEM: Carcinoma of the Cervix: Treatment by a Combination of Roentgen Rays, Radium, and Electrothermic Coagulation. RADIOLOGY, January, 1928, **10,** 57–61.

IDEM: Irradiation and Electrosurgery in the Management of Carcinoma of the Urinary Bladder. RADIOLOGY, January, 1934, **22,** 99–104.

DISCUSSION

DR. W. S. LAWRENCE (Memphis): Speaking on Dr. Stevens' paper, of course one practical trouble in pre-operative treatment of cancer of the breast is that one is liable to do so much good, and produce so much apparent improvement, and bring about nearly a cure that one of two things may happen: First, the surgeon may lose the case that he sent you—lose control of it; second, the woman may refuse to be operated on, although you may plead with her, scare her, caution her, everything you like. Sometimes she will quit you because you talk too much about operation. That is one practical point that comes into the concrete procedure or militates against the correct procedure in the irradiation of breast tumors.

A SIMPLIFIED METHOD OF BRONCHOGRAPHY[1]

By JACQUES FORESTIER, M.D., F.A.C.R.(HON.), *Paris*, Physician to Hôpital Reine-Hortense, Aix-les-Bains, *and* LOUIS LEROUX, M.D., *Paris*, Laryngologist at Hôpital Cochin, Paris

SINCE the year 1921, when we succeeded for the first time in visualizing the bronchial tree of the human with lipiodol with no untoward result for the patient, bronchography has extended its field yearly. It has proved to be helpful in a number of pulmonary diseases in which changes in the bronchial tubes may exist, but, even after thirteen years we feel that the whole field of bronchography has not been covered, and that added information can be obtained from improved technics and better interpretations of roentgenograms.

For several years we have used the transglottic method for the injection of opaque oil, injecting the oil by means of a long metallic catheter introduced directly into the trachea, after local anesthesia of the pharynx and larynx and under the control of the laryngeal mirror. One important feature in our technic has been the introduction of the intratracheal anesthesia previous to the injection of iodized oil. The principles which we established twelve years ago have been accepted almost unanimously.

The success of an injection of iodized oil into the bronchial tree depends upon the control of the cough. The latter can be controlled only by injecting a local anesthetic—cocaine, novocaine, or any similar compound—into the trachea itself before injecting the opaque oil. This anesthesia may not be necessary in therapeutic injections of small quantities of iodized oil in patients who have been trained to this particular technic, but it is necessary for diagnostic injections of large quantities of iodized oil in patients who experience such an injection for the first time.

We have always felt that the use and benefits of bronchography could be widely extended if there was a simplified method of injection which would enable any qualified physician to perform it without the additional help of one or more specialists. The simplified methods of J. J. Singer, of St. Louis, and of A. Ochsner, of New Orleans, have already rendered great services along these lines. They do not require the use of the laryngeal mirror, and the local anesthesia is easy to accomplish, yet many physicians have experienced some difficulty in obtaining a high percentage of successful results. Further improvement in technic is desirable.

THE PERNASAL METHOD

The method which we describe in this article is a derivative of that proposed by Hicquet and Hennebert, of Brussels. These authors proposed to inject the oil into the bronchial tree with a soft rubber catheter introduced into the nostril and further down into the pharynx, larynx, and trachea. We found that the same route could be followed without the use of any catheter, the oil, and, previously to it, the anesthetic, being injected directly into one nostril with an ordinary glass syringe exclusive of any tip or catheter of any sort. This method has been worked out with the help of our associate, Elisabeth Kudelski, at Hôpital Cochin, during the past two years. It has proved to be efficient in more than 90 per cent of the cases, and has been demonstrated in several hospitals or clinics in the United States during the recent visit of one of us (J. F.).

PRINCIPLES OF THE METHOD

The method is based on two principles:

(1) When the tongue is pulled out of the mouth and grasped firmly, the epiglottis is raised with the whole larynx, the upper orifice of the esophagus is closed, and the

[1] Presented before the Radiological Society of North America, at Memphis, Tenn., Dec. 3–7, 1934.

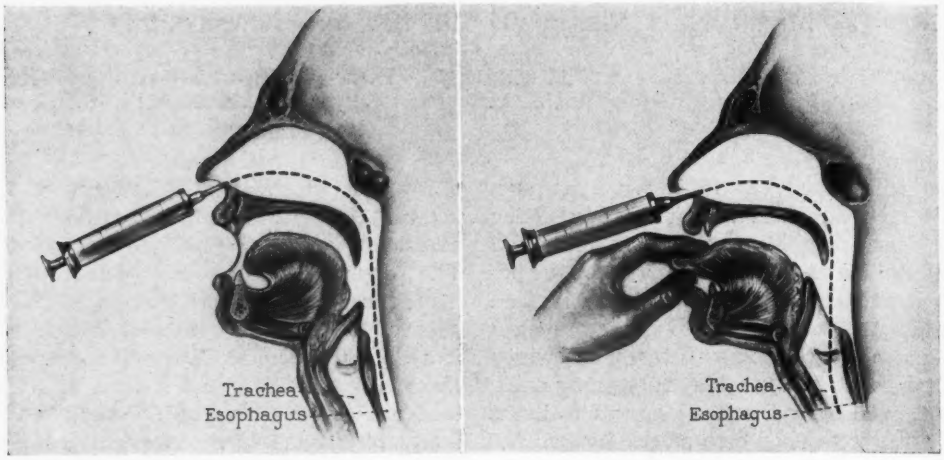


Fig. 1-*A*. Fig. 1-*B*.

Fig. 1. Pernasal method: A diagram demonstrating the action of the pulling of the tongue, after an injection of fluid into the nostril. (*A*) When the tongue remains in the mouth the esophagus is open, and the fluid is swallowed. (*B*) When the tongue is pulled firmly out of the mouth, the epiglottis is raised with the larynx, and deglutition cannot take place. The only possible way down offered to the fluid is the glottis.

patient is unable to swallow. This is, incidentally, the position for the examination with the laryngeal mirror. If any fluid comes into the pharynx in this position, the only way open below is the glottis (Figs. 1-*A* and 1-*B*).

Of course, such fluid can be injected directly at the base of the tongue with a short curved metallic catheter, but with this technic the fluid falls down briskly from a height of one or two inches against the pharyngeal mucosa, and is more apt to bring about some cough reflex than if it slides gently down, coming from the nose along the pharyngeal wall.

(2) The local anethesia of the pharynx, larynx, and trachea is made with exactly the same technic as the injection of iodized oil itself. The anesthetic solution is poured into the nostril and slides down to the glottis and later into the trachea, following exactly the same path which the oil will follow when bronchography is performed. Thus no laryngeal mirror, swab, or spray are necessary, and the technic can be performed by any qualified physician. It seems probable that the local anesthesia brought about by the cocaine solution on the nasal and pharyngeal mucous membranes helps to stop the cough reflex arising in the laryngeal vestibule. We know the favorable action of the local anesthesia of the lower meatus on trismus, and experience has proved that anesthesia performed through the pernasal route is more effective than by direct spray on the glottis.

Once the anesthesia of the larynx has been obtained, it will be necessary to anesthetize the tracheal bifurcation by injecting some more anesthetic, to penetrate into the bronchial tubes.

INSTRUMENTS AND SOLUTIONS

The instruments are as simple as possible, consisting of one 5 c.c. glass syringe for local anesthesia, and of one 20 c.c. glass syringe for the injection of opaque oil.

The anesthetic solution which we have used is made according to the following formula:

Cocaine hydrochloride		2.00 gram
Potassium sulphate		0.60 gram
Phenol		0.20 gram
Adrenalin chloride solution (1–1,000)		10.00 c.c.
Cherry laurel water		40.00 c.c.
Distilled water	q.s.	150.00 c.c.

We generally use the 40 per cent concentration of lipiodol without any mixture or

dilution. All fluids injected are previously heated to body temperature.

PERFORMANCE OF THE INJECTION

The performance of the injection consists of the following two phases: (1) local anesthesia; (2) injection of opaque oil.

Fig. 2. Pernasal method: Anesthesia of the larynx. Patient in sitting position.

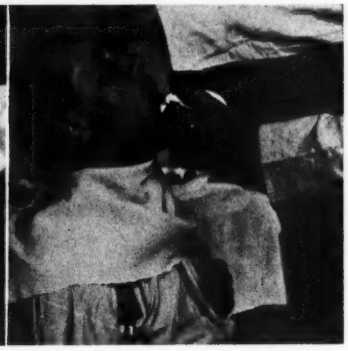


Fig. 3. Pernasal method: Position of the patient immediately after anesthetic has been injected.

1. *Local Anesthesia.*—In most cases it seems preferable, previous to the performance of bronchography, to give the patient one or two hours previously some form of sedative medicine—a small dose of chloral or luminal. In highly nervous patients a small quantity of morphine may be injected.

For the anesthesia, the patient must be in the sitting position, resting quietly against the back of a chair, and with the head raised at an angle of 45° (Fig. 2). We used to explain to the patient, previous to any maneuver, the different steps of the examination which is to be performed. Thus we gain his confidence and beg for his co-operation.

The tongue is pulled out of the mouth, held firmly in a piece of gauze with one hand, and the patient is asked to breathe naturally and quietly. It may be wise to protect the tongue from being eroded by the lower teeth by inserting a few layers of gauze between the latter and the lower aspect of the tongue.

(*A*) The first dose of 5 c.c. of the anesthetic solution is injected into one nostril in 5 or 10 seconds; at this moment, when the fluid has slipped over the palate into the pharynx and then into the larynx, the glottis, by a reflex, closes itself immediately. The patient remains a few seconds in apnea, at which moment it is essential to hold the tongue very firmly or otherwise deglutition will take place (Fig. 3). The patient upon being asked to breathe, will then open his glottis; the fluid will penetrate into the *trachea*, while a typical aspirating sound will be heard and a violent coughing fit will follow. When this fit is over, the tongue is released and the patient is allowed to expectorate a part of the anesthetic solution.

(*B*) Five minutes later, a second injection of 5 c.c. of the anesthetic solution is made with exactly the same technic. Generally it does not produce immediate cough, the fluid sliding down directly into the trachea, but when it reaches a bifurcation, a delayed fit of coughing appears, of lesser intensity than with the first injection.

(*C*) Five minutes later, *i.e.*, ten minutes after the first injection, a third injection of 5 c.c. of anesthetic solution is made. In most cases it brings about hardly any cough reflex, and it is the check that anesthesia has proceeded favorably. In very sensitive patients, a fourth injection of cocaine may be required, but this is an exception. It is recommended that the last anesthetic injection should be made in the

roentgenographic room, since it is desirable that the injection of iodized oil should be made as quickly as possible after it.

2. *Injection of Iodized Oil.*—It must be recalled that the distribution of the oil in the bronchial tree depends upon the position of the subject *at the time* of the injection. Gravity is the main factor in the distribution of the oil in the trachea and the main bronchi, but when the oil has reached the smaller divisions, it is kept in the lumen of the bronchial tubes by its high viscosity, and any position taken after the oil has reached these divisions has little influence, if any, upon the distribution of the oil.

We have made a rule to try to map out only one lung at a time, with from 20 to 30 c.c. in one injection. If we want to map out the opposite lung, bronchography can be repeated within a few days, and as the pernasal injection causes the patient the slightest possible discomfort, this procedure is very well accepted by patients.

Keeping these principles in mind, the following positions will be given to the patient, depending upon the area which is to be injected:

Base.—The patient must be sitting, slightly inclined on one side. This is the easiest field to reach (Fig. 4).

Middle lobe (right lung) or *upper part of lower lobe* (left lung).—The patient must be lying on the table, with the head slightly elevated, the corresponding shoulder lying on the table, the opposite shoulder lifted up on cushions which have been slipped behind the back of the patient.

Fig. 4. Pernasal method: Position of the patient for injection of lipiodol into the right base.

Fig. 5. Pernasal method: Position of the patient for injection of lipiodol into the right apex. Note the position of the right arm.

Upper lobe.—The patient must be lying on one side, the head slightly elevated, the corresponding shoulder pulled out to the edge of the table, the arm being lowered down as much as possible, while the opposite shoulder is lifted as for the middle lobe.

Experience has proved that it is more practical to make injections through the opposite side of the lung to be injected (Fig. 5).

ROENTGENOGRAPHIC TECHNIC

It is well to note that, for middle and upper lobes, the injection should be performed, if possible, on the roentgenographic table. There is no objection to performing the injection under fluoroscopic control. It is essential that the first exposure should be taken before there has been any coughing. Co-operation should be asked of the patient, and he should be begged to refrain from coughing at any cost until the films have been taken.

It is a matter of no small importance that the roentgenogram should be taken at the proper time after the injection. Since

bronchography has been helpful mostly for the study of the bronchial tree and not so much for that of the pulmonary parenchyma, it seems desirable that the film should be taken at the moment when the primary subsequent divisions of the bronchial tree are mapped out at their best. A careful study of the transit of opaque oil into the normal bronchial tree has been made by Mounier-Kuhn, who has described the following four phases:

(*A*) Transit through the trachea and the main bronchi. It lasts just a few seconds.

(*B*) Mapping out of the lobar bronchus. It lasts a few seconds more, and a film taken at that time shows exclusively the trachea and the main trunks; this view has been described as that of a "winter tree."

(*C*) Under the combined influence of respiratory movements and the injection of a further quantity of opaque oil, the mapping out of the smaller divisions of the bronchial tree takes place. This is the view described as the "spring tree." Such a view is obtained within three or four minutes after the beginning of the injection, and remains during three to five minutes more, when the last phase appears.

(*D*) The pulmonary alveoli are being filled through the influence of respiratory movements and absorption of residual air. The "foliage" is then visible; we have the view of the "summer tree." In that phase, the inumerable small shadows of the pulmonary alveoli overshadow the outlines of the bronchial tree, and such a picture is much more difficult of interpretation.

It has been our experience that the best moment to obtain a good visualization of the main bronchi and their further divisions is, as a rule, between three and five minutes after the beginning of the injection.

During the early periods of bronchography, the attention of the physicians has been especially drawn to the abnormal images obtained in mapping out the bronchial tree. It seems that the moment has come when the interest of this exploration should be focussed not only on the anatomic changes, but also on the functional defects of the bronchial tree. Experience has shown that, previous to the appearance of the abnormal shadows in a diseased bronchial tree, it was possible to detect those functional defects which express themselves in the delay of transit of the iodized oil.[2]

One of us has shown that in certain patients, who had been submitted to toxic gas during the War, the only perceptible radiologic change in the bronchial tree was a very important delay in the progress of the oil into the smaller divisions of the bronchi. The persistence of the picture in the form of a spring tree, ten or twenty minutes after the injection, is a definite proof that the peristalsis of the bronchial tree is impaired, and that there is a want of proper aspiration in the affected area.

For this reason the taking of several films at different intervals after the injection, in order to study the progress of the oil, is indicated.

In our opinion no complete interpretation of the film after bronchography can be made if the following data are not given: (1) Dose and temperature of iodized oil injected; (2) positions of the patient during the injection and during the taking of the roentgenograms; (3) time elapsed since the beginning of the injection. A rule should be made that such data should be provided with every film.

RESULTS OF THE METHOD

The results have been, as a whole, most satisfactory; very few failures having been encountered. Only one person out of several hundred is able to swallow the oil while the tongue is pulled out firmly. This procedure causes the patient as little discomfort as possible.

Fluoroscopy can be performed while the injection of iodized oil is made. We have succeeded in injecting patients with a very

[2] BONNAMOUR, S., and BADOLLE, A.: Roentgenography of the Normal Lung Following Injection of Lipiodol, and the Diagrams of Small Bronchiectasis. Presse Méd., 1929, **37**, 173–176.

irritable mucous membrane and in whom bronchoscopic injections had been a failure. In a limited number of cases, if failure is met with, the use of a catheter passed through the nose may lead to success.

In hospital work, from four to five patients may easily be examined almost at the same time, the anesthesia being begun for each of them one minute after the other, and the whole set of cases can be examined within less than half an hour. Incidentally, we note that the pernasal anesthesia may be used for other procedures, namely, bronchoscopy.

DANGERS

In our hands the method has proved to be without danger. In a limited number of cases patients have experienced some dyspnea during the time of the injection. A subcutaneous injection of camphorated oil with ether can control this symptom very easily. In case of active sinus or nasal infection, the pernasal route should be avoided.

If physicians fear the use of cocaine solution for tracheal anesthesia, it seems well to try some other salt of anesthetic solution. We have made it a point to be very careful with cocaine with our patients. If the latter have already been examined by a laryngologist and submitted to cocainization without disturbance, the above procedure is carried out without fear.

If, on the contrary, the patient has never been cocainized, a very small quantity (a few drops) of the solution is poured into the nostril, and symptoms of idiosyncrasy are watched. If they do not appear, the injection is performed with cocaine. In intolerant patients, perhaps novocaine or percaine may be used, but our experience with those solutions is too recent to permit of drawing definite conclusions about their efficiency. It may be suggested, if cocaine is feared in the bronchial tube, that it should be used for the first anesthetic injection only, the following ones being made with a less toxic preparation.

CONCLUSIONS

A simplified method of bronchoscopy is described. It does not require any special instrument, and can be carried out successfully by any qualified physician. It is hoped that it will widen the field of bronchography.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

THE FUTURE OF RADIOLOGY

In retrospect, the evolution thus far of the various contrast media has been as revolutionary in visual medical diagnosis as was the original discovery and medical use of the x-rays. The present generation in medicine missed the thrill of the pioneers in radiology who entered a totally unknown field of discovery a little over three decades ago, but, "lives there a man with soul so dead" among the present generation in medicine who has not felt the thrill of the pioneer at each presentation of a new technic and use of contrast medium. Each advance has sent radiologists scurrying to the operating room, laboratory, and postmortem room—and to burning the proverbial "midnight oil" over tomes of anatomy, physiology, pathology, chemistry, etc., and indeed recasting the small limits of our medical knowledge concerning things forgotten or not known.

We have witnessed the art of the skiagrapher pass and the science of radiology advance more rapidly than the technic of surgery or the diagnostic procedures slowly evolutionized through more than a hundred years of medical diagnosis. We have witnessed the polygamous wedding of radiology to every offspring of medical specialty and our inability or desire to obtain a divorce as an independent establishment or a separate science in medicine.

"A woman's place is in the home" say the opponents to the feminists who have forced a few million men out of jobs. "A radiologist's place is in the hospital x-ray laboratory" say the surgeons injecting air into the ventricles, the urologists performing retrograde or intravenous urography, the skin specialists treating over half their cases with the rays, the stomach specialists administering barium and the intravenous gall-bladder dye, the orthopedists raying and examining bones, the nose and throat specialists examining sinuses and mastoids. And so say the insurance companies, industrial medicalists, police surgeons, commercial laboratories, dentists, chiropractors, osteopaths and the other jungle paths—all equipped with x-ray apparatus. "The radiologist's place is in the hospital. He is a glorified technician of a sort. Long live x-rays!" So many say.

It has been a rapid step from the radiologist's back-yard construction of apparatus, to a billion dollars now invested in x-ray equipments as controlled for the manufacturer by government business codes. My generation chuckled before the depression as we watched x-ray manufacturers merge, for the scientific advance of radiology had no code. The advance of the pure physicist upon the atom has also been without a code. The advance of the radiologist into the future problems of medicine shall be without a code. The economic results of advance may be coded and it may slightly hinder further advance, but codes nor the Supreme Court shall stop scientific advance, for in science it is not gold that glitters first, last, and always as it does for business in a code.

As radiologists, we have quietly created quite a revolutionary advance in therapy and diagnosis. Professor Roentgen, by his discovery, did not cause a revolution in medicine and surgery. Instead, the whole medical world mobilized with x-rays so as to advance the science of medicine and surgery. The medical mobilization started by Roentgen has been the means of alleviating the suffering of millions. It is ghastly to realize that the mobilization of the nations at war destroyed millions of lives. Probably in the history of the next hundred years it may be taught little children that in their advanced scientific world there are far greater opportunities for achievement in the position of an obscure physicist, such as Roentgen, than to be a king or a czar.

Recently Henry Ford said: "Not long ago a newspaper quoted me as saying: 'There will be more scientific progress in the next fifty years than there has been in the last thousand years.' I did not like that," he added, "because it was in the next twenty-five years."

Perhaps many do not agree with Mr. Ford. But, over a thousand years ago scientists stated with grave deliberation that there was little more to be discovered. However, we do know that there is one thing which scientists are attempting to accomplish which, if it can

be controlled and utilized, shall more than fulfill Mr. Ford's prophesy, and put him out of the automobile business. The practical control and use of atomic energy within the next twenty-five years would revolutionize everything in this world connected with power. Physicists see the faint hope of accomplishment through radiology. Within the past few months a young physicist, investigating the atom, has perfected a single small million-volt apparatus that bids well to scrap our feeble and expensive deep therapy apparatus of to-day. Shall we have a small tube developed that "can take it?" Perhaps the logical answer may only be in belief as we see it, with a code passed by Congress to keep down the price of machines heretofore held up to the sky by the law of patents.

I recall a conversation a year or two ago with the assistant professor of roentgenology at one of the large eastern universities in which he discoursed at length upon the need for establishing radiology as a pure science in medicine.

The short-sighted economic urge of hospitals to make more money out of the x-ray department at the radiologist's expense and by exploiting him had aroused the professor to the need of such a position for radiology. I was surprised at his lack of vision for the future. It would be no more possible to separate radiology as a pure science in medicine than it would be to divorce medical men from wielding a scalpel, the examination of urine or tissue, or passing a cystoscope. No doubt there are many who feel like the professor, overburdened with long hours before a stack of films, or a screen, or at the controls of a deep therapy machine, attacking immediate routine problems of radiology in a busy clinic.

It is true that the qualified radiologist is the only proper person to be in full charge of the activities of the x-ray department. The future shall see the responsibilities increase. There would be unspeakable dangers otherwise, but, outside the great hospitals in the larger cities, radiologists have long since recognized many changes that are taking place. There is no fight on now for recognition of the importance of the x-ray in diagnosis or therapy. The days have passed since the radiologists were heaped with ridicule at medical meetings while discussing, for instance, the chest. My generation has witnessed some of that ridicule when radiologists were describing "fan-like densities and translucent areas" in the lung-fields. Difference of opinion in regard to a diagnosis remains as it should remain, while we match our wits over the patients of our medical confrères, but public ridicule and scoffing shall never occur again except as they are deserved by the unskilled. It seems petty to even mention such things now, but my generation has seen radiologists purple with humiliation when they knew they were right. Our work with the x-rays now is a pure science only as medicine or surgery is a pure science, and as medical men we accomplish great things.

The future? The x-rays and radium have given and proven so much in the problems of medicine that no physician may conscientiously afford to disregard his duty to the patient by disregarding the use of radiology in diagnosis and treatment when needed to-day. It is said that the general practitioner can well handle 80 per cent of his problems without the use of x-rays. It may be possible to say that he can *handle* pretty close to 100 per cent if he does not know his responsibilities, or if he is lucky enough to escape the courts in a malpractice fracture suit after setting a bone poorly without the use of available x-rays. Being personally satisfied with a diagnosis, without using all available assistance for a correct one, is one way of handling a patient, be it from the lack of a microscope, reagents for a urine examination, a blood pressure apparatus, x-rays, or stomach pump. But at this stage of advance in the science of medicine a physician's conscience should rest only when he has availed himself of every means at hand to get his patient well. Again, it seems needless to mention such things, but in considering the future for the x-ray specialist it would appear wise during these times of economic confusion to view many angles. The future of the radiologist has for many years depended upon the medical profession's understanding of when and how to use the skill of the radiologists. The radiologists have maintained high standards of ethics as knowledge has advanced. I think that most radiologists in the large medical centers to-day examine or treat only those patients sent to them through a physician: at least, this has been my practice for some years while located near a large medical center. However, outside the large cities an entirely different situation must necessarily maintain. There may not be enough radiological work to support the radiologist and he finds himself working, along with it, in other and broader

medical fields. You may say that such men are not skilled in x-ray diagnosis, but if the radiologists from the large medical centers should take the trouble to investigate, they would find many of these men skilled and better doctors because of their endless search for more knowledge from the film or screen. Watch them pass a cystoscope and examine a bladder, pass ureteral catheters for a functional kidney test and retrograde pyelography, search for red cells and casts under the microscope, or tubercle bacilli from the urine. See them perform an intravenous urography and interpret an electrocardiogram. Aye! watch them treat their patients and, while you are at it, investigate the countryside where the electric current penetrates and find out how many doctors can to-day, within ten minutes, pull a portable x-ray machine out of a motor car and assemble it on the second floor outside a patient's room, to be wheeled in and used at will. To know some of these things and witness the uncanny diagnoses, is to see a young generation of better doctors working and getting somewhere with medicine. For them, there is no mystery about making a film or screening a patient during these days of simplified apparatus. If there still is a mystery about it, then many of these physicians, not members of x-ray societies, seem to be attempting to solve it, and, what is most important, getting somewhere with diagnoses.

In the large cities the gastro-enterologists, urologists, skin specialists, eye-ear-nose-and-throat specialists, orthopedic surgeons, dentists and others are all falling in line in private practice and equipping themselves for their individual needs. As radiologists, we see many of their terrible mistakes, but, as a stepping stone to the ultimate diagnosis, the x-ray is passing rapidly from limited hands to being a tremendous aid in medicine under the numerous well-trained hands of many and divers eminent specialists in many fields, who know much more concerning their own special field than many radiologists in general diagnosis. True, the limitations of x-ray diagnosis may be such that a general diagnostician in radiology may not be required to know all of the intricate problems of the various special fields. But to stand on the borderland and view but the screen or film, as many a radiologist has found out, is frequently to be standing soon in one's own "no man's land." The advance of radiology by radiologists of the present and future shall be made by those who are able to see beyond their range of vision of the screen or film, and by specializing within the specialty. The borderland position is occupied by many radiologists to-day and they are worse off than the country radiologist (if you may call him such, as I have described his activities above), for that chap in the country is pushing his investigations beyond the film to the function of the kidney, to the heart, and to metabolism as well, so that he can judge what he personally may do in the complete general care of the case.

Recently I talked with a prominent radiologist concerning the present inducements offered for the young man entering the x-ray field. We agreed concerning a lengthy training and adequate foundation for the work. Our discussion led to the sad situation of the hospital exploiting the radiologist so as to make more money for the institution. He blamed a great deal of it to the perfection of apparatus and to the ease with which a technician these days may perform the radiographic work. That, and the ease with which it is possible to motor rapidly from one hospital to another over good roads, made it perfectly logical to him that a radiologist could easily and adequately attend to the radiological work of several hospitals. Such work is always badly done. He has three city hospitals, none of which are under two hundred and fifty beds each, and one of them is much larger. He works by schedule. I wondered how many times a week this man stood beside the surgeon in the operating room to view the pathology he had declared the surgeon would find; how many times during the week he viewed a post-mortem, saw a tissue slide, examined a heart, read a detailed history, or thoroughly discussed a clinical problem with the referring physician or the specialist in the clinical laboratory. I wondered also what observation and check he was making of his therapy cases.

This good friend of mine is a borderland radiologist and underpaid, possibly because he is a borderland radiologist overworked and dashing about for a living, meeting three hospital schedules and attempting to copy the style of the surgeon whose chief job per patient is a short session in the operating room with resident nurses, and an assistant afterward performing the most of the work as the patient is recovering in bed; a film-reader is not doing justice to himself or his patients and crowding

at least one skilled radiologist out of a job. Young men interested in radiology know that such a type of radiologist, not fulfilling all his duties as a consultant, is in truth a skiagrapher either by choice or economic necessity and is regarded by most men on the staff as a skiagrapher first and a doctor last. During these hard times this skiagrapher may easily find a good radiologist for a hundred a month and take on still another hospital that decides it has too expensive a radiologist—one who has refused to be exploited. It is quite clear what this procedure is doing for the future of radiology, as lay business managers of hospitals are cutting to the bone.

As from year to year radiology has shouldered greater responsibilities in the rapid advance into all fields of medicine, the majority of staff physicians wish cheaper x-ray fees for the increasing needs of their patients and so they frequently combine to obtain it through the board and manager. Consequently fixed fees are becoming the established custom for the future, as has been the case for some time in the chemical or clinical laboratory. In most large hospitals I believe that the future shall see more radiologists placed upon a fixed salary and occupying somewhat the position of the laboratory men. The days of the personal lucrative private fees is nearly over in the public hospital x-ray department. A percentage of the net may last for a while but that soon shall pass. Of course, this is unjust.

It is my belief that the private outside x-ray laboratory must in time give way to the hospitals. The necessity for large fees to maintain overhead and install expensive new apparatus as needed is too great an undertaking for the younger man. If he undertakes it after a few years as chief of a hospital x-ray department, he runs the serious chance of losing his position on the staff, for the board and manager shall consider him as essentially a laboratory man and will not tolerate competition off-hand. Of course, this is an unjust attitude, but the staff usually does not make any active defense of the radiologist against the board and manager in such a situation, for too frequently the staff consider that it is to their interest to have more and cheaper service. It will become increasingly difficult for the private x-ray laboratory to compete with the hospital.

Physicians everywhere are becoming better educated to the use of the x-rays. Small, efficient, and cheap apparatus is here. There are difficulties ahead for the physicians, but they will attempt to master them as they have had to master the microscope, the basal metabolism apparatus, and the electrocardiogram which have become available for private office work. They will not be the leaders in the x-ray world but they will be discovering much data and see things they never saw before, and from an instrument in their own hands. I believe that it is an excellent thing for them, and for the radiologists, because it will drive out those individuals unethically grasping too many hospitals. It will also educate the physician to the need for skill in the radiologic field.

My war generation had few texts on this subject at first, and x-ray articles were scarce. We saw gas tubes, cumbersome machines, and glass plates quickly pass out of the picture. We came into the field with knowledge of the dangers of burns. It seems but yesterday that high speed screens and films cut exposure time more than in half. Tiny self-rectifying units can now give excellent chest detail faster than one can open or close a switch. My generation saw the Potter-Bucky diaphragm enter the field, and we successfully speeded it up for stomachs, kidneys, and gallbladder work. For good films, the days of romance and guess-work have passed. X-ray protection comes with the tube, and it is controlled otherwise easily and at will. Mechanical rectification soon is to become a thing of the past.

A medical student, these days, can pick out from the film a tuberculous infiltration the size of one's thumb nail in the upper lobe of a lung. We have all seen the most skilled of diagnosticians, with no knowledge of the film, miss such a lesion from an examination of the patient. We have seen such tiny spots grow from month to month until finally, after the loss of much valuable time, the clinician admitted they were there. Do you suppose the general practitioner has not found that out, and that we, as radiologists, in such a series of examinations can not declare definitely that active tuberculosis is there? Will the manufacturers give to these practitioners what they now wish, as Ford did to the public when he took luxury out of car-ownership? I think that they will.

My generation has seen more consistent and progressive enthusiasm in x-ray society meetings than has existed in the society meetings of any other medical group. Some of our

medical confrères used to joke about them as being mutual admiration societies, but we were exchanging knowledge and getting somewhere rapidly. Our publications were centered chiefly in one x-ray journal. All that has changed and we have disseminated knowledge everywhere. The shadows of mystery have been cleared up, and the shadows of pathology remain. There are more x-ray demonstrations of pathology in medical and surgical journals now than in the few x-ray journals: the latter are largely archives for the splendid presentations made at the society meetings. I believe that as time goes on the "American Journal of Roentgenology and Radium Therapy" and RADIOLOGY should harbor more and more of those presentations as their greatest function and use.

I predict a closer bond between general medicine and the radiologists within the next decade and a half, with far greater revolutionary advancements in diagnosis and therapy accomplished than we have known in the past twenty years. We already see many men specializing within the specialty. To-day they are the ones contributing the masterpieces of writing which are consistent with the logical dignity and conservatism of advance in other special fields. Some of the older men have recognized the necessity of sifting out the chaff of many radiologists, who dash wildly here and there at every extreme so as to get into print.

It is an inspiring thing to watch many of the older men direct the activities of their heirs in radiology. Those pioneers in radiology have labored and lived to see the present zenith of excellence in the specialty, as it has been guided to great heights of accomplishment under their skilled hands, applied for such noble assistance in the various fields of medicine. Their records of accomplishment have been engraved into the annals of medicine throughout the world. The present position of radiology, as it exists in the closest cooperation with problems in all fields of medicine, could not have been guided by more skilled hands. So many have been noble martyrs in a great cause. We younger men following in their footsteps are thankful for their accomplishments, for, by their clearing the obstacles from the path that has led to the present successful and irrevocable attainments in radiology, we have been spared the heartaches and discouragements which they encountered as pioneers in establishing this specialty in its present enviable position of excellence in medicine. The quotation, "He is a poor pupil who does not exceed his master," does not apply here, for never again in the history of radiology shall opportunities in like form be presented.

To-day radiology stands well upon the threshold of opportunity for occupying a keystone position in an uncertain future trend of the economic development in medicine which is rapidly approaching. In this respect the future status of radiology, and in many ways the economic future of medicine, depend in no small measure upon the radiologists who are so intimately associated with the necessary field for advance. The future promises many changes from what the imaginations of our predecessors in medicine, who, through the generations established and maintained such splendid and unexcelled traditions, were able to conceive.

In therapy lies a great future for radiologists. It is bound to become an exclusive field in the hands of able pathologists. It is a great satisfaction to radiologists to realize the remarkable advance of knowledge they have had to grasp while treating neoplasms. My generation saw deep therapy announced for treating cancer with somewhat of the authority of the "Hax Pax Max" of mystic wizard fame. Money was not spared in installing the machines. We witnessed the percentage doses pass to the international r unit and logical reason. Nobly that great pathologist, James Ewing, and others struggled with us—encouraging here and there, ruthlessly ripping wide open many of our asinine ideas. I, with many others, travelled the continent, following the "will o' the wisp" cure for cancer. I spent all I had, to return a wiser and better man, attempting to settle down logically in radiology while the battle raged.

In therapy, my generation witnessed the practical entry of the ionization chamber and listened to the physicists expound it—most of which went over our heads. I recall the long silences following those technical eulogies. We rushed madly into ionization physics. We saw chambers modified by as many in number as there were physicists, with charts that would not agree, until finally came the international r. We then proved to the physicists that we had to remember the patient in terms of biological units. The physicists

stole the show for a while, but now once again all is peaceful and calm.

The future of therapy? It is the great unknown. Indications are that we have but just scratched the surface to-day. We do not know the chemical mystery that takes place within the cell which may suddenly cause it to grow wild. I predict that some day it shall be known and that radiology, in combatting it, shall occupy the most prominent place. In neoplastic work, we, with the pathologists and biochemists, are the pioneers of to-day. We would like to live to see the great truth dawn. We, who receive the inoperables, would give thanks and there would be great joy.

As an important duty, there remains that we may see to it that the best of the younger generation enters this field. My generation has learned full well what we lack from the groundwork up. The medical staffs of the radiological departments of the great teaching centers must be increased, to enable young men to specialize within the specialty, or, otherwise, much from the radiological centers will be distributed to other special workers, who will use this method of diagnosis and therapy in more concentrated and narrow fields. With this in view, the teachers of radiology should urgently seek exclusive endowments for the chair and department, or radiology as a specialty will be absorbed. If many could see the light now, much future economic distress could be avoided: otherwise, there will follow a struggle for a subsidy from the general fund of the university for the purpose. In view of the uncertain economic trends in store for medicine as they exist to-day, I predict that soon, in the great teaching centers, the majority of the teachers in roentgenology will receive a fixed salary. It is regrettable, but I think that it is inevitable.

There is no longer any necessity for young medical men to receive their instruction and experience in radiology in a haphazard way, as many of my generation received them, as barnacles attached to a few of the pioneers. The universities should have more regular, endowed post-graduate courses in radiology. The British are far ahead of us in this, majoring physics, anatomy, physiology, chemistry, and pathology much more exhaustively than are required for a medical degree. The Cambridge course is the best of its kind in the world. As a member of the British Institute of Radiology, I have for many years carefully followed their advance. They are a conservative lot of men. Their youngsters in radiology are being forced to the bottom of things. We shall hear much from them in the next few years. Until recently, the British radiologists faced an unprecedented depression, continuous since the war, as did the other radiologists on the Continent. They saw no boom days as did we in 1929.

At the British Institute of Radiology the visitor every day may see students reading in the radiological library filled with American, German, French, and Italian texts. Films in library form, under the care of a curator, are available upon all subjects—films sent by radiologists to this center from all parts of Great Britain. I do not know where such things may be seen in North America. In South America, yes—but not here. In Japan, one may spend many enjoyable days in a library of films, with courteous Japanese attendants ready to translate the concise and neatly printed records.

No one has ever listened much to the proposal I made years ago for an American Institute of Radiology in Washington with a museum, a librarian, and curator for films. I suppose the Cleveland disaster is still a mental hazard, though most of us use non-inflammable films. But I still believe that some day we shall have an American Institute of Radiology. Perhaps then a reprint service may be of great help to those of us not fortunate enough to be connected with a university service, where a well-paid staff translates and classifies the literature from various parts of the world.

The hospitals are profiting by the exploitation of many radiologists at present, but the time may come when the staffs of hospitals will be better educated in regard to the infinite detailed care and labor connected with *good* radiological work. Also, in regard to the need for patients paying a physician for such services at a rate commensurate with that received by our brother specialists in other fields of medicine. However, such an Utopia for the future appears doubtful. At present, it is frankly true that many of the staff unfortunately do not know the truth, and so radiologists of either mediocre ability or hopelessly in financial despair, are content to let the situation rest as it is—somewhat of the situation of "letting a sleeping dog lie." But time may change all that, though lay high pressure business managers of hospitals will be the first

and last always in opposition to any future change from that unfortunate position into which many radiologists have been forced during the depression. Many of us who have refused to be exploited have fallen by the wayside.

With more post-graduate courses in radiology available at the teaching centers in this country, more post-graduate degrees in radiology could be conferred by the universities, but we have a long way to go in this country before adequate courses are established in sufficient number to supply the needs for skilled men. One has but to consider the average physician's woeful lack of knowledge concerning radiological diagnosis and therapy to realize that the establishment of more such post-graduate courses must be accomplished chiefly through the efforts of radiologists.

Lucrative fees have kept the heads of many prominent radiologists completely in the fog, but the field is too great for making a closed corporation out of radiology, as it suspiciously exists in some centers. The younger generation has had preliminary educational advantages far surpassing the groundwork possessed by many of my generation. Dissatisfaction among the younger men at the inability to find instruction or appointments is adding coals to the fire, as hospital managers cut the incomes of radiologists to the bone. The end is not yet. A great economic re-adjustment must come about, for radiology has leaped out of bounds.

My generation had nothing to do with bringing about the war and this cursed depression, but we are doing considerable thinking about it all and sometimes with bitterness. These are frightful and dangerous times of social cruelty for many millions of our people. The future of our social and political structure sways to the right or to the left each month as history is made. "Get what you can while you can get it" seems to be the slogan of the mob, as a stricken nation gropes about for relief and light. Never before in the history of this country have medical men had a better opportunity to carry out the age-old tradition handed down to them—that of placing the interests of the patients above their own. Radiologists have done this bravely during these times and have had little to say concerning many injustices meted out to them. As Pasteur and Lister contributed much to filling up the great unknown gap between the bedside and postmortem table, so likewise has Roentgen's discovery contributed much. One might well consider that, for the welfare of the world, the scientists in medicine in as many years of advance have contributed more than the inventors and industrial giants.

There may be considerable satisfaction for medical men in maintaining a dignified silence as the industrialists howl loudly now, following the catastrophe they have brought about, but at present those interested in the future advance of radiology in particular should heed the economic trends, obviously stifling more and more of individual initiative and indeed detrimentally influencing the future of this great special field of medicine.

An educational campaign for radiology is clearly indicated. Once or twice annually, in local x-ray society meetings, there should be a frank discussion of the economic trend in hospitals insofar as it effects radiologists. There should be more radiological contributions made to medical magazines other than those centered about radiology. Radiologists should take more interest and actively participate in all groups of medical society meetings. Public health problems, more particularly, the examination of school children, may open many avenues for widespread public education. Public education through the radio, and particularly information concerning the early diagnosis and treatment of cancer, is of importance. More effort should be made to participate in the activities of the hospital associations in which many laymen are interested. The radiologist's minority position on the hospital staff necessitates his becoming active in staff committees, and standing in closer contact with lay members of the hospital board. The lady board of managers or ladies' committees are not to be overlooked, and the need for radiological endowments kept in mind. The future lies in the hands of the men to follow, so the hospital resident physician should receive the full concentration of the radiologist. In other words, there are opportunities for radiologists to participate in procedures in every field in which medical men are interested, for the best interests of the whole profession and the public.

The only way for physicians and others to receive knowledge of the intricate and difficult problems in radiology is through the radiologists. In such a position, the radiologist should possess all the requisites of the consul-

tant and share in all the responsibilities that the name implies.

GEORGE U. PILLMORE, M.D.
Haverford, Pa.

ANNOUNCEMENT

AMERICAN BOARD OF RADIOLOGY

EXAMINATIONS

The Board will not be in session at the meeting of the American Roentgen Ray Society, but will convene at Detroit just preceding the meeting of the Radiological Society of North America. So many applications were on file that the Board was unable to consider all of them in its session at the meeting of the American Medical Association at Atlantic City in June, and some of them had to be deferred until the Detroit meeting. New applicants who wish to appear before the Board at Detroit will be considered in the order in which the applications are received, but only until the quota is filled, and the new applications should be on file at least sixty days before the meeting.

COMMUNICATION

MEDICAL SOCIETY OF THE STATE OF NEW YORK

SECTION ON RADIOLOGY

The One Hundred and Twenty-ninth Annual Meeting of the above Society was held in Albany, May 13–15, 1935. Donald S. Childs, M.D., of Syracuse, Chairman of the Section, presided the Vice-chairman being L. P. Larkin, M.D., of Ithaca, and the Secretary being J. M. Flynn, M.D.. of Rochester.

The papers presented before the Section were as follows:

"A Study of the End-results in the Treatment of Cancer Patients, with a Report of Approximately 400 Autopsies." Ira I. Kaplan, M.D., New York City. Discussion was opened by Angelo M. Sala, M.D., of New York City.

"Trichobezoar." Carlton F. Potter, M.D., of Syracuse.

"Review of 5,000 Gastro-intestinal X-ray Examinations, with a Summary of the Conclusions." Edward C. Koenig, M.D. Discussion was opened by L. P. Larkin, M.D., of Ithaca.

"X-ray Therapy of Upper Respiratory Infections." A. L. L. Bell, M.D., of Brooklyn.

"Pulmonary Tuberculosis: Serial Roentgen Studies in Superinfections." Henry K. Taylor, M.D., of New York City. The discussion was opened by G. G. Ornstein, M.D., of New York City.

"Pneumoconiosis: Study of Some 500 Cases." Clifford G. Orr, M.D., of Buffalo. Discussion was opened by Donald R. McKay, M.D., of Buffalo.

"Radium Therapy." Douglas Quick, M.B., of New York City. Discussion was opened by Burton D. Simpson, M.D., of Buffalo.

"The Use of the Roentgen Ray in the Early Diagnosis of Infections Caused by Gas-forming Organisms." L. R. Lingeman, M.D., of Rochester. Discussion was opened by Max A. Almy, M.D., of Rochester.

"The Relationship of Certain Technical Factors in the Roentgenological Examination of the Lungs." C. C. McCoy, M.D., of Cooperstown.

IN MEMORIAM

WALTER F. HENDERSON, M.D.

A member of this Society, Walter F. Henderson, M.D., of Jackson, Miss., passed away on April 18, 1935. He was graduated from Millsaps College, Jackson, Miss., in 1912, and from Vanderbilt University Medical School, Nashville, Tenn., in 1916. Dr. Henderson did postgraduate work in roentgenology at Tulane University, New Orleans, at Johns Hopkins University, Baltimore, and at the University of Michigan, Ann Arbor. He had practised general medicine in Shreveport, La., previous to taking up the study of roentgenology, but after leaving the Army he devoted himself to that specialty. He became director of the roentgen department of the Baptist Hospital of Jackson, Miss., in 1925. He was well known in New Orleans, where he was director of the roentgen department of Touro Infirmary until compelled by failing health to resign.

Again, upon his return from the Mayo Clinic, where he went for operation for gastric ulcers, he resumed the directorship at the Baptist Hospital of Jackson. There his death occurred.

Dr. Henderson was a member of his local, State, and national medical societies, as well as two fraternities. He has left many friends to mourn his passing, and his medical confrères have lost a capable young roentgenologist who gave promise of achieving still more notable work in his chosen specialty of roentgenology.

ROBERT PAINE, M.D.

Robert Paine, M.D., radiologist, recently passed away at the Methodist Hospital, Memphis, Tenn., following a week's illness with pneumonia. He was 43 years of age.

A native of Mississippi, Dr. Paine attended Branham-Hughes preparatory school, Vanderbilt, and was a graduate of Jefferson Medical College, studied at the Crile Clinic, Cleveland, and had special courses at Massachusetts General Hospital, Boston, and at Harvard Medical School. He also served two years at the Methodist Hospital, Memphis. He practised in Aberdeen, Miss., prior to coming to Memphis, where he became associated with W. S. Lawrence, M.D., in the practice of general radiology.

Dr. Paine served during the World War for two years as captain in the Medical Corps. He recently received a commission as a major in the Medical Reserve Corps. He was a member of the American Medical Association, Radiological Society of North America, Memphis and Shelby County Medical Society, Tennessee State Medical Society, Memphis Roentgen Club, and was an instructor in radiology in the medical department, University of Tennessee.

Leading members of the Memphis medical profession acted as pallbearers at Dr. Paine's funeral, paying respect to their fellow-physician.

ABSTRACTS OF CURRENT LITERATURE

CONTENTS BY SUBJECT

Dosage 759
Nervous System 759
Physico-chemical Effects 759
Pneumothorax 759
Radium 760
Thyroid (Therapy) 760
Tumors (Diagnosis) 760
Tumors (Therapy) 760

THE FOLLOWING ABSTRACTORS HAVE CONTRIBUTED TO THIS ISSUE

E. A. POHLE, M.D., Ph.D., of Madison, Wisconsin
WILLIAM A. SODEMAN, M.D., of New Orleans, La.
CHARLES G. SUTHERLAND, M.D., of Rochester, Minn.

CONTENTS OF ABSTRACTS IN THIS ISSUE, LISTED ALPHABETICALLY BY AUTHORS

CATHCART, J. W. The Radiologist and the Goiter Problem 760
CRAIG, WINCHELL MCK., *with* HARRINGTON, STUART W., jt. auth. 760
DESPLATS, R. The Effect of Roentgen Rays on the Sympathetic Nerve and the Adrenals in Functional Disturbances Due to Trauma ... 759
DESPLATS, R. Functional Radiotherapy of the Sympathetic Nerves and Suprarenals in Vasomotor Sequels of Trauma 759
ERNST, H. W., FRIK, KARL, and OTT, PAUL. Measurements of the Distribution of Roentgen Rays for Short Focal Distances 759
FRIK, OTT, *with* ERNST, H. W., jt. auth. 759
HARRINGTON, STUART W., and CRAIG, WINCHELL MCK. Mediastinal and Intraspinal Perineural Fibroblastoma (Hour-glass or Dumbbell Tumor) Removed by One-stage Operation 760
KELLER, F. The Determination of Radium Isodose Curves in r; Corrections Based on New Experimental Studies 760
LIEBER, G. D. Physico-chemical Effect of Roentgen Rays on the Organism 759
MELCHART, FRANZ. The Treatment of Lymphogranulomatosis with High Doses of Roentgen Rays 760
MYERS, J. ARTHUR. Artificial Penumothorax 759
OTT, PAUL, *with* ERNST, H. W., jt. auth. 759
ROFFO, A. H. The Effect of Light on the Development of Normal and Neoplastic Cells Grown *in Vitro* 759

DOSAGE

Measurements of the Distribution of Roentgen Rays for Short Focal Distances. H. W. Ernst, Karl Frik, and Paul Ott. Strahlentherapie, 1935, **52,** 389–402.

In the last few years a number of investigators have reported encouraging results with the use of high doses of roentgen rays (heavily filtered) at short focal skin distance of from 2 to 10 cm. in the treatment of superficially located malignancies. The authors studied, therefore, the distribution of radiant energy in air and in the water phantom under these conditions. They found that the isodose curves could be changed at will by varying the F.S.D. and the filter. Several examples were shown in the article, illustrating the fact that the distribution of radiant energy can be adapted to the location and size of the tumor. While the results obtained in water may be transferred without great error to tissue, it is not advisable to use such curves obtained with one apparatus on another without adequate calibration tests.

ERNST A. POHLE, M.D., Ph.D.

NERVOUS SYSTEM

The Effect of Light on the Development of Normal and Neoplastic Cells Grown *in vitro*. A. H. Roffo. Strahlentherapie, 1935, **52,** 525–530.

The author found that the susceptibility of neoplastic fibroblasts to light is greater as compared with fibroblasts in normal hearts of chicken embryos. A definite inhibition of growth was seen if the cancer cells were exposed to a 25-watt lamp with 2 per cent of 7,500 Å. Complete inhibition of growth was seen after exposure to a 40-watt lamp with 8 per cent of 7,500 Å. On the other hand, the fibroblasts in the heart of chicken embryos continued to grow even after exposure to a 100-watt lamp with 34 per cent of 7,500 Å.

ERNST A. POHLE, M.D., Ph.D.

Functional Radiotherapy of the Sympathetic Nerves and Suprarenals in Vasomotor Sequels of Trauma. R. Desplats. Jour. de Radiol. et d'Electrol., November, 1934, **18,** 575. (Reprinted by permission from British Med. Jour., Jan. 12, 1935, p. 12 of Epitome of Current Medical Literature.)

The author has tried suprarenal radiotherapy in painful osteoporosis following injury in four cases. In all, there was immediate relief of the pain, disappearance of the muscular contracture, and freeing of the joint movements; progressive clearing up of the edema and loss of the feeling of heat, and the gradual terminating of the osteoporotic state. For this radiotherapy in fracture cases, Desplats uses a dose of 250 r over each suprarenal region, and repeats the radiation twice. There is generally a rapid improvement unless the fracture is of long duration, when two or three series of exposures, separated by intervals of three weeks, may be necessary. This procedure should be employed especially in cases of fractured neck of the femur, when convalescence can be shortened thus, and any tendency to a resulting osteo-arthritis be checked. The vascular readjustment achieved by this form of radiotherapy is also effective in such conditions as traumatic arthritis, congenital dislocation of the hip, or the senile morbus coxæ. Radiation in the suprarenal areas, with intervals of rest, ends the pain, usually by the third or fourth session; lessens any contracture brought about by muscular movement; abolishes muscular cramps, and diminishes claudication and, later on, the extent of muscular atrophy. The author insists on the value of this distant radiation, though admitting that some of its results can be produced by local application of x-rays. The action is primarily on the vasomotor conditions which accompany or follow the traumatic lesions, and the benefit is usually lasting.

PHYSICO-CHEMICAL EFFECTS

Physico-chemical Effect of Roentgen Rays on the Organism. G. D. Lieber. Strahlentherapie, 1935, **52,** 497–511.

The author exposed neutral, positive, and negative solutions of hemoglobin to roentgen rays (125 K.V., 4 mm. cardboard, 300 H). Macroscopically, there were no changes in the test solutions. If neutral solutions were added to the irradiated neutral and acid solutions, they appeared to be more sensitive than the unirradiated controls. The irradiated neutral hemoglobin solutions showed a little more opacity than the controls; the sedimentation velocity was increased. In the acid sols these two phenomena were even more pronounced. Little effect was seen in the negative sol.

ERNST A. POHLE, M.D., Ph.D.

PNEUMOTHORAX

Artificial Pneumothorax. J. Arthur Myers. Jour. Am. Med. Assn., Oct. 27, 1934, **103,** 1299.

Itard coined the word "pneumothorax" in 1803 to designate the existence of air in the pleural cavity. Nature demonstrated that a lung may be partially or completely collapsed while the opposite lung carries on adequately the respiratory functions of the body. Observation revealed the fact that marked improvement of pulmonary disease occurred following spontaneous pneumothorax. These facts brought to light great possibilities in both the diagnosis and treatment of chest diseases.

The author discusses the method of administration, the complications, the effect on normal and on diseased lung tissue, and the use of the method in diagnosis. He reviews its application to the treatment of pulmonary tuberculosis and touches on its use in bronchiectasis, pulmonary abscess, and lobar pneumonia. The technic is given in detail. The complications are gas embolus, spontaneous or accidental pneumothorax, serous effusion, empyema, mediastinal hernia, febrile reaction, pain, and subcutaneous emphysema.

In moderately and far advanced tuberculosis, successful pneumothorax shortens the period of bed-rest necessary, renders the sputum negative, and closes cavities if the walls are not too thick. In minimal progressive lesions it prevents the sputum from becoming positive or, if positive, renders it negative and controls the disease and frequently obviates hospitalization and strict bed-rest.

Pregnancy is an indication rather for than against pneumothorax. Treatment by pneumothorax with the patient remaining ambulatory is possible for selected cases, including elderly persons. It is indicated in children if the lesion is of the reinfection type. Minimal cases should continue at least two years, and moderately or far advanced cases from three to five years or even longer.

CHARLES G. SUTHERLAND, M.D.

RADIUM

The Determination of Radium Isodose Curves in r; Corrections Based on New Experimental Studies. F. Keller. Strahlentherapie, 1935, **52,** 403–424.

An apparatus is described by the author which permits the calibration of radium screens in r. He states that gamma rays may be measured with ionization chambers in r (absolute), provided that the wall material furnishes the same number of photo-electrons, the same number of Compton electrons as air, and that the electrons produced are absorbed at the same rate as in air. The measurements show that the results are definitely dependent on the thickness of the chamber wall. The amount of back-scatter in water or tissue depends also on the chamber wall material, the thickness of the wall, and the filtration of the radium. In no case was the back-scattering equivalent to the amount of radiation absorbed. It is concluded that for every type of radium screen, special isodose curves in r must be determined in order to permit correct dosage.

ERNST A. POHLE, M.D., Ph.D.

THYROID (THERAPY)

The Radiologist and the Goiter Problem. J. W. Cathcart. Texas St. Jour. Med., March, 1935, **30,** 703–706.

From a series of 84 cases treated by irradiation—either x-ray or radium, as the circumstances permitted—Cathcart believes that irradiation is of therapeutic value comparable to surgery in hyperthyroidism, except when complicated by an excess size of the gland due to cysts or the presence of large amounts of fetal adenomatous tissue. He considers irradiation superior to surgery in adolescent enlargement with thyrotoxic symptoms when treated before the age of 20. Added advantages are the economic status during treatment, zero mortality from the procedure, and the absence of pain and suffering.

WILLIAM A. SODEMAN, M.D.

TUMORS (DIAGNOSIS)

Mediastinal and Intraspinal Perineural Fibroblastoma (Hour-glass or Dumb-bell Tumor) Removed by One-stage Operation. Stuart W. Harrington and Winchell McK. Craig. Jour. Am. Med. Assn., Dec. 1, 1934, **103,** 1702–1704.

This is a case report of an hour-glass or dumb-bell tumor in which the extra-spinal portion of the tumor was in the mediastinum and encroached on the adjacent intrathoracic structures. This involved the double surgical problem of combining the procedures for an intraspinal and an intrathoracic tumor. The tumor was removed successfully in one stage; the authors were unable to find record of this having been accomplished before.

Roentgenologic examination of the thorax disclosed a circumscribed shadow of soft tissue at the fifth and sixth ribs posteriorly on the left side. A localized roentgenogram of the spine revealed erosion of the pedicle of the fifth dorsal vertebra and upper border of the sixth on the left. The tumor was extruding through the intervertebral foramen between the fifth and sixth dorsal spines and into the mediastinum. The intervertebral foramen was eroded and enlarged by the extruding tumor. There was increase in width of the fifth intercostal space and erosion of the posterior inferior border of the fifth rib and posterior superior border of the sixth rib. A roentgenographic diagnosis of neurofibroma of dumb-bell type, invading both spine and mediastinum, was made.

Intratracheal anesthesia was administered with a positive pressure apparatus so that the intrapulmonary pressure could be controlled. The patient was transferred immediately after operation to the oxygen chamber, where she was kept for a period of ten days. Convalescence was uneventful and a letter received four months after the operation reported her condition as excellent.

CHARLES G. SUTHERLAND, M.D.

TUMORS (THERAPY)

The Treatment of Lymphogranulomatosis with High Doses of Roentgen Rays. Franz Melchart. Strahlentherapie, 1935, **52,** 460–463.

The author advocates the use of fairly high doses in the treatment of all involved glands in patients with Hodgkin's disease, combined with general body exposure. The glands receive 200–240 r per area and three fields are given per day until the glands disappear. The total surface dose amounts sometimes to from 2,000 to 4,000 r for involved glands and 800 r for areas irradiated prophylactically. The general body exposure is carried out at 1–2 meters distance and from 50 to 100 r are given per sitting. As a rule the leukocytes drop down to 2,000, but they recover under As-Fe medication and liver diet within from eight to twelve weeks.

ERNST A. POHLE, M.D., Ph.D.

INDEX TO VOLUME 24
SUBJECTS

ABSCESS
Bronchopulmonary segment, with special reference to putrid lung abscess (ab.), A. Glass, 385.
Lung abscess (ab.), H. Brunn, 383.
Pulmonary abscess in children, Diagnosis and treatment of (ab.), D. T. Smith, 255.

AMIDOPYRINE
Agranulocytic leukopenia: report of case successfully treated with x-rays, and some observations on effect of amidopyrine (ab.), J. E. Benjamin and J. B. Biederman, 376.

ANEMIA, pernicious
Roentgenologically demonstrable gastric mucosal atrophy in pernicious anemia, Concerning question of (ab.), R. Pape, 645.

ANESTHESIA, nitrous oxide
Encephalography under nitrous oxide anesthesia (ab.), R. W. Waggoner and L. E. Himler, 509.

ANEURYSMS
Dilatation of pulmonary arch in roentgenologic cardiac silhouette: four cases of aneurysm of pulmonary artery (ab.), L. Holst, 642.

ANGINA, agranulocytic
Agranulocytic leukopenia: report of case successfully treated with x-rays, and some observations on effect of amidopyrine (ab.), J. E. Benjamin and J. B. Biederman, 376.

ANIMAL EXPERIMENTATION
Blood sugar of rabbits, Influence of roentgen irradiation on, and suitability for blood sugar experiments (ab.), J. Engelbreth-Holm, 509.
Epilation of rabbit skin following irradiation (ab.), G. H. Klövekorn, 386.
Histological studies of liver, spleen, and bone marrow in rabbits following intravenous injection of thorium dioxide (ab.), E. A. Pohle and G. Ritchie, 378.
Reaction of lung tissue to roentgen rays (ab.), R. B. Engelstad, 644.
Roentgen study of absorption by lymphatics of thorax and diaphragm of thorium dioxide injected intrapleurally into animals (ab.), L. J. Menville and J. N. Ané, 256.
Studies of biologic effect of cathode rays (ab.), W. Gentner and F. Schmidt-La Baume, 125.
Treatment of unilateral urinary fistulas by x-ray destruction of kidney: clinical and experimental study (ab.), N. P. Sears, 383.

ANTRUM
Cured carcinoma of nose and antrum (ab.), M. H. Shutes, 638.

AORTA
Carditis and aortitis, Roentgen therapy of (ab.), B. Jegorow, 515.

APPENDICITIS
Chronic appendicitis, Roentgenologic diagnosis of (ab.), A. Bejul and L. Holst, 637.
Chronic appendicitis, Solution of roentgen diagnostic problem in: conclusions based upon studies covering period of twenty years and including comparative analysis of roentgenological, clinical, surgical, and postmortem findings (ab.), T. Scholz, 505.
Chronic appendicitis, Spontaneous (ab.), M. Cerf, 637.

APPENDIX
Pathological appendix (ab.), J. Felsen, 376.

ARTERIES, splenic
Calcification of splenic artery, J. E. Heatley, 235.

ARTHRITIS
Bone lesions in children, J. I. Mitchell, 715.
Chronic arthritis, Medical aspects of, R. A. Kinsella, 413.
Chronic arthritis, Medical treatment of (ab.), R. L. Cecil, 505.
Chronic arthritis, Orthopedic and physical therapeutic treatment of (ab.), L. T. Swaim, 505.
Chronic arthritis, Treatment of: general principles (ab.), E. E. Irons, 505.
Radiotherapy, physical therapy, and hyperpyrexia in treatment of arthritic disturbances, Relative value of, J. C. King, 411.
Roentgen diagnosis of chronic arthritis, H. P. Doub, 391.
Surgery as adjunct to treatment of arthritis, W. C. Campbell, 398.

gonorrheal
Experience with short wave therapy in gynecology, particularly in tumors of adnexa (ab.), E. Vogt, 253.

ASTHMA
Diagnostic and therapeutic value of intratracheal use of iodized oil in cases of intractable asthma, with special reference to its use as contrast medium and physicochemical mechanism on which its therapeutic value is based, R. M. Balyeat, L. E. Seyler, and H. A. Shoemaker, 303.

BACKACHE
Oblique view for demonstration of articular facets in lumbosacral backache and sciatic pain (ab.), R. K. Ghormley and B. R. Kirklin, 257.

BACTERIA
Volume-increase of bacteria from x-ray irradiation, T. J. Dietz, 31.

BILIARY TRACT
Applied physiology of extra-hepatic biliary tract (ab.), A. C. Ivy and G. S. Bergh, 379.
Biliary colic fistula, H. B. Podlasky, 345.

BIOLOGIC EFFECTS
Have cosmic rays demonstrable biologic effects? (ab.), R. B. Engelstad, 379.
Present status of roentgen therapy with voltages above 200 K.V.: technical development and medical application (ab.), T. Leucutia and K. E. Corrigan, 506.

BIOPSY
Evaluation of roentgen treatment of laryngeal carcinoma: report of cases, I. S. Hirsch and S. M. Baum, 281 (287).

BLADDER
Clinical value of bladder pressure estimations (ab.), K. H. Watkins, 253.
Complications following radium therapy of tumors of bladder and neighboring organs (ab.), W. I. Korchow, 127.
Hernia of bladder, Traumatic interstitial (ab.), R. J. White, 514.
Granuloma of bladder (ab.), A. F. Weyerbacher and J. F. Balch, 514.
Postpartum pyelitis of pregnancy: treatment of certain cases without use of ureteral catheter: explanation based on physiology of bladder (ab.), D. K. Rose, 382.
Pre-sacral sympathectomy and urinary bladder (ab.), E. D. McCrea and A. D. McDonald, 253.
Use of radium in carcinoma of bladder (ab.), A. J. D. Smith, 127.

BLOOD
Alterations in *P*H of blood in cancer following roentgen and gamma irradiation (ab.), J. W. Schoonover, E. H. Shiels, and B. P. Widmann, 378.
Blood picture in pulmonary tuberculosis, especially relation between sedimentation and shifting to left (ab.), S. Cold, 648.
Fibrinogen content of blood under influence of roentgen irradiation and primary effect of radiation (ab.), A. Held and H. Hülbach, 386.
Roentgen therapy of diseases of blood (ab.), R. Pape, 637.

pressure, high
Radiotherapeutic treatment of hypertension and diabetes, J. H. Hutton, 330.

sugar
Influence of roentgen rays on blood sugar in man, Studies regarding (ab.), K. Brochner-Mortensen, 650.
Roentgen irradiation on blood sugar of rabbits, Influence of, and suitability for blood sugar experiments (ab.), J. Engelbreth-Holm, 509.

BONES, anomalies
Hereditary synostoses of small bones of hand and foot: *os tibiale externum* (ab.), J. Mestern, 390.
Os acetabuli (ab.), E. Freedman, 507.
Patella of elbow: contribution to anomalies of skeleton (ab.), K. Kremser, 253.

atrophy
Congenital atrophy of thumb, Two cases of: reconstruction by bone graft (ab.), C. Parisel, 637.

cancer
Cancer metastatic to bone, W. A. Fort, 96.
Epithelioma involving cartilage, Treatment of, using 220 K.V.P. and heavy filtration, E. A. Merritt and R. R. Rathbone, 701.

diseases
Epithelialization of chronic osteomyelitic cavities: precancerous lesion, A. Brunschwig, 627.
Familial bony dystrophy with multiple exostoses, H. A. Yenikomshian and H. K. Blake, 623.
Juvenile osteitis deformans Paget, Two cases of (ab.), R. Hummel, 377.
Kaschin-Beck's disease, Roentgen symptomatology of (ab.), W. Graziansky, 638.
Köhler's disease, Some reflection on etiology of, A. Zeitlin, 360.
Osteitis deformans (Paget's disease) and syphilis of bone, Differential diagnosis of (ab.), T. Canigiani and K. Singer, 376.
Osteodystrophia fibrosa unilateralis (ab.), K. Goldhamer, 123.
Paget's disease as accidental finding (ab.), T. Barsony and K. Winkler, 376.
Parathyroid deossification, Roentgenographic studies of (ab.), J. J. Moore and A. A. de Lorimier, 376.
Pseudarthrosis of leg, Congenital: three cases treated by massive bone graft (ab.), P. C. Colonna, 506.
Rhizomonomelorheostosis, B. P. Widmann and W. R. Stecher, 651.
Schüller-Christian disease after x-ray therapy, living and under observation eleven years, M. B. Radding, 591.

BONES, diseases—continued
X-ray experimental studies showing that rachitic rats with healed bone lesions continue to show alteration in their gastro-intestinal tract, L. J. Menville, J. N. Ané, and S. N. Blackberg, 74.
Xanthomatosis involving bone (lipoid histiocytosis): case reports and roentgen findings, L. A. Smith, 521.
fragility
Osteogenesis imperfecta: report of two cases (ab.), S. Kleinberg, 252.
transplantation
Congenital atrophy of thumb, Two cases of: reconstruction by bone graft (ab.), C. Parisel, 637.
tuberculosis
Bone lesions in children, J. I. Mitchell, 715.
Osteitis tuberculosa multiplex cystica, with report of two cases, J. H. Vastine and E. P. Bacon, 22.
tumors
Bone lesions in children, J. I. Mitchell, 715.
Bone sarcoma, Contribution to etiology and roentgen diagnosis of, with remarks concerning "osteo-arthropathie hypertrophiante pneumique" (ab.), J. Palugyay, 123.
Bone sarcoma, Studies in. III. Experimental and pathological study of rôle of periosteum in formation of bone in various primary bone tumors (ab.), A. Brunschwig and P. H. Harmon, 646.
Ewing's sarcoma, Treatment of: results in Zürich (ab.), R. Stewart-Harrison, 646.
Osteogenic sarcoma: pathologic characteristics, C. Phillips, 728.
Osteogenic sarcoma: roentgenologic characteristics, R. T. Wilson, 708.
Osteosarcoma in course of Paget's disease of bones (ab.), J. Haguenau, L. Gally, and P. Daum, 123.
Roentgen therapy of bone sarcoma (ab.), K. Goldhamer, 389.
BOOK REVIEWS
Béclère, Henri, *with* Duval, Pierre, jt. auth.
Cole, Lewis Gregory, Pound, Robert Earl, Cole, William Gregory, Morse, Russell Wright, Headland, Courtenay Inglis, and Naslund, Ames William, Radiologic Exploration of Mucosa of Gastro-intestinal Tract, 634.
Cole, William Gregory, *with* Cole, Lewis Gregory, jt. auth.
Duval, Pierre, Roux, Jean Charles, and Béclère, Henri, Radiologie Clinique du Tube Digestif: I—Estomac et Duodenum, 501.
Headland, Courtenay Inglis, *with* Cole, Lewis Gregory, jt. auth.
Holmes, Harry N., Out of the Test Tube, 250.
Janker, Robert, Views of Normal Skeleton, its Hereditary and Acquired Changes, 249.
Katz, J. R., Roentgenspectrography as Method of Studying High Molecular Substances, Colloids, Animal and Vegetable Tissue, 502.
Morse, Russell Wright, *with* Cole, Lewis Gregory, jt. auth.
Naslund, Ames William, *with* Cole, Lewis Gregory, jt. auth.
Polevski, J., Heart Visible: Clinical Study in Cardiovascular Roentgenology in Health and Disease, 373.
Pound, Robert Earl, *with* Cole, Lewis Gregory, jt. auth.
Roux, Jean Charles, *with* Duval, Pierre, jt. auth.
Wegelius, Carl, Investigations Concerning Possibility of Outlining Inner Organs of Human Body Roentgenographically in Three Dimensions, 502.
BRAIN, tumors
Encephalographic experiences: medico-legal deductions, E. S. Gurdjian and H. A. Jarre, 85.
Ventriculography in diagnosis of intracranial tumor (ab.), L. C. E. Lindon, 649.
BREAST, cancer
Carcinoma of breast, Simultaneous radium and roentgen therapy of (ab.), F. Melchart and W. Schloss, 507.
BRONCHIECTASIS
Radiologic picture of bronchiectasis (ab.), M. Belli, 516.
BRONCHOGRAPHY
Bronchography, essential and safe adjunct in study of pulmonary tuberculosis (ab.), J. E. Murphy, 388.
Bronchography in relation to pathology of pulmonary tuberculosis (ab.), B. P. Potter, 388.
Serial bronchography for diagnosis of purulent diseases of lungs (ab.), P. L. Farinas, 384.
Simplified method of bronchography, J. Forestier and L. Leroux, 743.

CALCIFICATION
Calcification of splenic artery, J. E. Heatley, 235.
Myocardial calcification (ab.), J. J. Moore, 515.
CALCULI
Gallstones and their diagnosis in gall bladder not filled by dye (ab.), E. A. Zimmer, 380.
Review of 162 consecutive personal cases of stone in upper urinary tract (ab.), H. P. Winsbury-White, 253.
Urinary stone formation, Some newer conceptions of (ab.), J. D. Barney and E. R. Mintz, 377.
Urologic problems in childhood, W. J. Engel, 183 (185).
CANCER
Carcinoma of cecum: what are chances of cure? (ab.), C. E. Dixon, 378.
Histological classification of cancers of uterine cervix and relation between growth structure and results of radium treatment (ab.), H. Chambers, 649.
Lobectomy for pulmonary cancer, Elapse of three years without recurrence of cancer following: successful termination of pregnancy during free period (ab.), J. Divis, 638.
campaigns
Social and economic aspects of cancer, A. Soiland, 213.
diagnosis
Are we making progress in diagnosing cancer in early stages? (ed.), 239.
Carcinoma of bronchus or lung, Diagnosis and treatment of primary (ab.), E. A. Graham, 124.
Carcinoma of lung, Diagnosis of primary, C. H. Heacock and J. C. King, 452.
Carcinoma of small intestine, Early diagnosis of (ab.), K. Hohenner, 377.
Carcinoma of stomach in girl 21 years of age, W. J. MacFarland, 494.
Colonic lesion, W. H. McGuffin, 114.
Gastric cancer, Some phases of roentgenologic diagnosis of (Carman Lecture), B. R. Kirklin, 672.
Primary carcinoma of duodenum: case report (ab.), P. C. Swenson and A. G. Levin, 378.
Roentgenology, Debt of surgery to, D. C. Balfour, 684.
metastasis
Cancer metastatic to bone, W. A. Fort, 96.
patient
Shall we tell cancer patient truth? (ed.), F. A. Riebel, 496.
Should patient be told: further comment, 247.
therapy
Alterations in *p*H of blood in cancer following roentgen and gamma irradiation (ab.), J. W. Schoonover, E. H. Shiels, and B. P. Widmann, 378.
Benign stricture of intestine due to irradiation of carcinoma of cervix uteri (ab.), E. N. Collins and T. E. Jones, 254.
Cancer of mouth and cervical lymphatics, Management of (ab.), D. Quick, 377.
Cancers of rectum, Contribution to technic of radium application in (ab.), E. Hesse, 646.
Cancers of uterine cervix and relation between growth structure and results of radium treatment, Histological classification of (ab.), H. Chambers, 508.
Cancer therapy with extremely hard roentgen rays, Preliminary report concerning our three years' experience in (ab.), E. v. Schubert, 124.
Carcinoma, Hyperintensive irradiation of certain types of: preliminary report (ab.), H. Lammers, 508.
Carcinoma of bladder, Use of radium in (ab.), A. J. D. Smith, 127.
Carcinoma of breast, Simultaneous radium and roentgen therapy of (ab.), F. Melchart and W. Schloss, 507.
Carcinoma of cervix, Incidence of vaginal fistulæ in patients with (ab.), F. R. Smith, 125.
Carcinoma of cervix, Intravaginal irradiation at close range of (ab.), H. Martius, 260.
Carcinoma of cervix, Results in treatment of, by Women's Clinic of University of Breslau (ab.), W. Reiprich, 390.
Carcinoma of fundus uteri and of post-menopausal metrorrhagia, Roentgen therapy of (ab.), P. Gibert and L. Solomon, 507.
Carcinoma of larynx and hypopharynx, Preliminary results obtained by teleradium therapy in, in Lund, 1931–1933 (ab.), L. Edling, 639.
Carcinoma of lip, Roentgen therapy of, with short F.S.D. (ab.), H. Chaoul, 639.
Carcinoma of nose and antrum, Cured (ab.), M. H. Shutes, 638.
Carcinoma of ovary, Our results in treatment of (ab.), C. Schroeder, 256.
Cancer of palatine tonsil and pillars, Radium therapy of (ab.), A. S. d'Emidio, 127.
Carcinoma of pharynx, Roentgen therapy of (ab.), H. Coutard, 508.
Carcinoma of pharynx and larynx, Treatment of, L. H. Garland, 261.
Carcinoma of stomach, Modification of radiation treatment of, I. I. Kaplan, 735.
Carcinoma of uterus, Combination of radiation therapy with chemotherapy in (ab.), L. Havlasek, 639.
Carcinoma of vocal cords by "window" method, Radium treatment of (ab.), R. Müller, 645.
Chemotherapy as supplementary treatment in radiation therapy of malignant disease (ab.), F. Nahmmacher, 125.
Coutard's method of treating cancer by irradiation therapy (ed.), 364.
Epitheliolysis, Radiotherapeutic significance of, with special consideration of oral, pharyngeal, and laryngeal carcinomas (ab.), J. Borak, 252.
Epithelioma involving cartilage, Treatment of, using 220 K.V.P. and heavy filtration, E. A. Merritt and R. R. Rathbone, 701.
Epithelioma of cheek, Treatment of (ab.), G. E. Pfahler, 99.
Fichera method in carcinoma therapy, Our experience with (ab.), G. Schulte and W. Lutteken, 639.
Filtration in Coutard method, Purposes and significance of (ab.), J. Jovin, 639.
Intra-oral cancer and its treatment, O. N. Meland, 276.
Laryngeal carcinoma, Evaluation of roentgen treatment of: report of cases, I. S. Hirsch and S. M. Baum, 281.

Malignancy, Rôle of radiotherapy in problem of (ab.), E. E. Shepley, 639.
Malignant diseases, Preliminary or pre-operative and pre-radium irradiation in management of, J. T. Stevens, 739.
Malignant tumors, Influence of ultra-short electrical waves on (ab.), E. Hasché and W. A. Collier, 124.
Neoplasms of mouth and throat, Protracted external irradiation in treatment of: comparison of x-rays, 5-gram radium pack, and 100-milligram radium pack, M. Friedman and R. Rosh, 7.
Ovarian carcinoma, Value of irradiation in treatment of (ab.), J. H. Harris and F. L. Payne, 508, 639.
Pharyngeal cancer, Symposium on treatment of, by divided or protracted dose principle of external radiation (ed.), H. E. Martin and M. Lenz, 364.
Roentgen therapy, Data concerning three years' experience with 600 K.V. (peak) (ab.), S. G. Mudd, C. K. Emery, O. N. Meland, and W. E. Costolow, 507.
Skin cancer and its cure, Stubborn (ab.), A. Hintze, 124.
Superficial malignancies, Irradiation treatment of (ab.), H. D. Kerr, 639.
Teleradium therapy with roentgen rays, Attempt to imitate (ab.), E. Ebbehoj, 639.
Tumors of bladder and neighboring organs, Complications following radium therapy of (ab.), W. I. Korchow, 127.
Uterine carcinoma, Development of radiation therapy of (ab.), A. Lacassagne, 260.
Uterine carcinoma, Radiation therapy of (ab.), F. Voltz, 260.
Uterine carcinoma, Supplementary radium treatment in roentgen therapy of (ab.), H. Wintz, 260.

CARBUNCLE, therapy
Carbuncle of kidney (ab.), J. A. Lazarus, 254.

CARCINOMA. *See* **Cancer**

CARMAN LECTURE, 671.

CARTILAGE
Treatment of epithelioma involving cartilage using 220 K.V.P. and heavy filtration, E. A. Merritt and R. R. Rathbone, 701.

CATHODE RAYS
Possibilities of high speed cathode rays in therapy (ab.), A. Brasch and F. Lange, 125.
Radiobiological experiments undertaken as basis for use of high speed cathode rays in therapy (ab.), R. Glocker, G. A. Kugler, and H. Langendorff, 125.
Studies of biologic effect of cathode rays (ab. , W. Gentner and F. Schmidt-La Baume, 125.

CECUM, cancer
Carcinoma of cecum: what are chances of cure? (ab.), C. E. Dixon, 378.

CELLS
Cytologic study of living body irradiated with hard ray. Pt. I. Influence of hard ray upon development of beans and abnormality of nuclei and cell division (ab.), T. Saito, 127.

CHEEK, cancer
Treatment of epithelioma of cheek, G. E. Pfahler, 99.

CHEMOTHERAPY
Chemotherapy as supplementary treatment in radiation therapy of malignant disease (ab.), F. Nahmmacher, 125.
Radiation therapy with chemotherapy in carcinoma of uterus, Combination of (ab.), L. Havlasek, 639.

CHEST
Degree of inspiration from chest film, Simple method for determining, K. D. A. Allen and H. D. Waltz, 225.
Esophagus in relation to heart, aorta, and thoracic cage, Study of, S. Brown and J. E. McCarthy, 131.

CHILDREN
Bone lesions in children, J. I. Mitchell, 715.
Congenital lung cysts in infants and children, S. G. Schenck and J. L. Stein, 420.
Initial tuberculous infection, Effect of, on subsequent tuberculous lesions (ab.), J. A. Myers and F. E. Harrington, 388.
Intestinal invagination in children (ab.), L. O. Christensen, 641.
Intestinal invagination in children (ab.), J. Nordentoft, 642.
Lead poisoning in children, Diagnosis of (ab.), M. Kasahara, 643.
Malignant tumors of kidney in children: with report of six cases. E. A. Pohle and G. Ritchie, 193.
Pulmonary abscess in children, Diagnosis and treatment of (ab.), D. T. Smith, 255.
Simple method for determining degree of inspiration from chest film, K. D. A. Allen and H. D. Waltz, 225.
Urologic problems in childhood, W. J. Engel, 183.

CHOLECYSTOGRAPHY
Cholecystographic diagnosis: management and technic for oral cholecystography, D. S. Beilin, 218.

COLITIS
Syndrome of hypertonic and atonic colopathy (ab.), F. H. Kruse, 511.

COLON
Colon studies: VII. Variations in fixation of cecocolon; clinical significance (ab.), J. L. Kantor and S. Schechter, 510.
Colon syndrome, Irritable, C. J. Laus, 572.
Colonic lesion, W. H. McGuffin, 114.
Diseases of colon, Roentgen diagnosis of: evaluation of methods (ab.), H. M. Weber, 513.
Hypertonic and atonic colopathy, Syndrome of (ab.), F. H. Kruse, 511.
Regional (terminal) ileitis: roentgen diagnosis (ab.), J. L. Kantor, 512.

CONTRAST MEDIA
Bronchography, Simplified method of, J. Forestier and L. Leroux, 743.
Certain diagnostic phases of excretion urography, A. E. Jones and R. A. Arens, 169.
Diagnostic and therapeutic value of intratracheal use of iodized oil in cases of intractable asthma, with special reference to its use as contrast medium and physico-chemical mechanism on which its therapeutic value is based, R. M. Balyeat, L. E. Seyler and H. A. Shoemaker, 303.
Histological studies of liver, spleen, and bone marrow in rabbits following intravenous injection of thorium dioxide (ab.), E. A. Pohle and G. Ritchie, 378.
Multiple urograms: aid in urological diagnosis, E. C. Baker and J. S. Lewis, Jr., 177.
Roentgen study of absorption by lymphatics of thorax and diaphragm of thorium dioxide injected intrapleurally into animals (ab.), L. J. Menville and J. N. Ané, 256.

COSMIC RAYS
Have cosmic rays demonstrable biologic effects? (ab.), R. B. Engelstad, 379.

COUTARD'S METHOD OF IRRADIATION
Coutard's method of treating cancer by irradiation therapy (ed.), 364.
Radiotherapeutic significance of epitheliolysis, with special consideration of oral, pharyngeal, and laryngeal carcinomas (ab.), J. Borak, 252.
Symposium on treatment of pharyngeal cancer by divided or protracted dose principle of external radiation (ed.), H. E. Martin and M. Lenz, 364.

CYSTS
Cyst of lung, Congenital, J. L. Dubrow, 480.
Lung cysts in infants and children, Congenital, S. G. Schenck and J. L. Stein, 420.
Pancreatic cysts, Roentgen diagnosis of (ab.), J. Monauni, 644.

DIABETES MELLITUS
Radiotherapeutic treatment of hypertension and diabetes, J. H. Hutton, 330.

DIATHERMY
Influence of ultra-short electrical waves on malignant tumors (ab.), E. Hasché and W. A. Collier, 124.

DIET
Nourishment in cases of radiological reaction in mucous membranes of mouth and throat (ab.), K. Palmstierna, 649.

DIGESTIVE TRACT
Proteins *versus* carbohydrates: inquiry into their gastric digestion (ab.), M. E. Rehfuss, 381.

DUCTLESS GLANDS. *See* **Endocrine glands.**

DUODENUM
Duodenitis and roentgenologic characteristics (ab.), B. R. Kirklin, 512.
Inflammation of descending portion of duodenum: preliminary report, M. L. Sussman, 691.
Primary carcinoma of duodenum: case report (ab.), P. C. Swenson and A. G. Levin, 378.
Roentgenologic investigation of results of suturing of perforated gastric and duodenal ulcers (ab.), A. Lob, 644.
Unstable or irritable duodenum: clinical observations in 100 cases (ab.), J. Friedenwald and M. Feldman, 380.

DYSPNEA
Dyspnea (ab.), J. C. Meakins, 518.

ECHINOCOCCOSIS
Echinococcus cyst attached to kidney: case report (ab.), M. J. Geyman and D. M. Clark, 516.
Perforated echinococcus of liver and spleen, Roentgenologic demonstration of (ab.), F. Berner and F. Meythaler, 643.

ELBOW
Patella of elbow: contribution to anomalies of skeleton (ab.), K. Kremser, 253.

ENCEPHALOGRAPHY
Encephalographic experiences: medico-legal deductions, E. S. Gurdjian and H. A. Jarre, 85.
Encephalography under nitrous oxide anesthesia (ab.), R. W. Waggoner and L. E. Himler, 509.

ENDOCRINE GLANDS
Basophilic adenoma (pituitary basophilism): report of case, with clinical improvement of systemic manifestations after iradiation of pituitary, M. G. Wohl, J. R. Moore and B. R. Young, 53.
Detailed anatomy of sella turcica and its clinical significance for recognition of size of hypophysis; contribution to study of relationship of size of hypophysis and size and form of sella turcica to anatomic and functional hypogenitalism (ab.), O. Bokelmann, 128.
Hyperthyroidism by roentgen irradiation of pituitary gland, Treatment of, J. Borak, 535.

ENDOCRINE GLANDS—continued
Radiotherapeutic treatment of hypertension and diabetes, J. H. Hutton, 330.
Urinary stone formation, Some newer conceptions of (ab.), J. D. Barney and E. R. Mintz, 377.
ERYSIPELAS
Roentgen therapy of erysipelas (ab.), C. Kruchen, 640.
ERYTHEMA
Spectrophotometric studies on human skin with special consideration of determination of degree of erythema and pigmentation (ab.), H. G. Bode, 128.
ESOPHAGUS
Disturbed peristalsis of esophagus, with formation of pseudo-diverticula (ab.), J. Palugyay and G. Pesek, 509.
Study of esophagus in relation to heart, aorta, and thoracic cage, S. Brown and J. E. McCarthy, 131.
Varices of esophagus (ab.), G. Wachner, 640.
EXOSTOSES
Familial bony dystrophy with multiple exostoses, H. A. Yenikomshian and H. K. Blake, 623.
EYE
Roentgen therapy of post-traumatic cyst of iris (ab.), M. Lüdin and A. Bader, 379.
Simple technic for radiography of optic canals (ab.), C. Fava, 510.

FEMUR
Fractures of neck of femur, dislocations of hip, and obscure vascular disturbances producing aseptic necrosis of head of femur (ab.), D. B. Phemister, 253.
Ununited intracapsular fractures of femoral neck roentgenographically considered (ab.), A. W. George and R. D. Leonard, 379.
FEVER
Medical aspects of chronic arthritis, R. A. Kinsella, 413 (416).
Relative value of radiotherapy, physical therapy, and hyperpyrexia in treatment of arthritic disturbances, J. C. King, 411.
FINGERS AND TOES
Congenital atrophy of thumb, Two cases of: reconstruction by bone graft (ab.), C. Parisel, 637.
FISTULA
Biliary colic fistula, H. B. Podlasky, 345.
Treatment of unilateral urinary fistulas by x-ray destruction of kidney: clinical and experimental study (ab.), N. P. Sears, 383.
FOOT
Unilateral periosteal thickening of metatarsals (ab.), A. Zeitlin, 379.
FOREIGN BODIES
Foreign bodies in intestines (ab.), C. Jackson and C. L. Jackson, 640.
Method of roentgen localization of foreign bodies in stomach prior to gastroscopic removal (ab.), G. Tucker, 510.
FRACTURES
Fracture of dorsum sella: report of case, M. L. Allen, 111.
Fractures of neck of femur, dislocations of hip, and obscure vascular disturbances producing aseptic necrosis of head of femur (ab.), D. B. Phemister, 253.
Ununited intracapsular fractures of femoral neck roentgenographically considered (ab.), A. W. George and R. D. Leonard, 379.

GALL BLADDER
Applied physiology of extra-hepatic biliary tract (ab.), A. C. Ivy and G. S. Bergh, 379.
Cholecystographic diagnosis: management and technic for oral cholecystography, D. S. Beilin, 218.
Diverticulum of gall bladder (ab.), J. H. Vastine, 510.
Gallstones and their diagnosis in gall bladder not filled by dye (ab.), E. A. Zimmer, 380.
Mechanism of rapid cholecystography, Some studies on (ab.), A. Capua, 510.
GANGRENE, gas
Roentgenologic examination for diagnosis and treatment of gas gangrene of extremity, Importance of (ab.), J. Schneider, 380.
GAS
Saturation potentials in ionized gases (ab.), E. Both, 650.
GASTRO-INTESTINAL TRACT
Apparatus for serial radiography and demonstration of mucosal relief in gastro-intestinal examinations, J. C. Bell, 143.
Benign stricture of intestine due to irradiation of carcinoma of cervix uteri (ab.), E. N. Collins and T. E. Jones, 254.
Carcinoma of cecum: what are chances of cure? (ab.), C. E. Dixon, 378.
Carcinoma of duodenum, Primary: case report (ab.), P. C. Swenson and A. G. Levin, 378.
Carcinoma of small intestine, Early diagnosis of (ab.), K. Hohenner, 377.
Carcinoma of stomach, Modification of radiation treatment of, I. I. Kaplan, 735.
Colon, Roentgen diagnosis of diseases of: evaluation of methods (ab.), H. M. Weber, 513.
Colon studies: VII. Variations in fixation of cecocolon; clinical significance (ab.), J. L. Kantor and S. Schechter, 510.
Colon syndrome, Irritable, C. J. Laus, 572.
Colonic lesion, W. H. McGuffin, 114.
Disturbed peristalsis of esophagus, with formation of pseudo-diverticula (ab.), J. Palugyay and G. Pesek, 509.
Diverticula of fundus of stomach, L. W. Paul, 47.
Duodenitis and roentgenologic characteristics (ab.), B. R. Kirklin, 512.
Extensive malignant lesions of stomach, Treatment of (ab.), W. Walters, 519.
Foreign bodies in intestines (ab.), C. Jackson and C. L. Jackson, 640.
Gastric cancer, Some phases of roentgenologic diagnosis of (Carman Lecture), B. R. Kirklin, 672.
Gastric physiology, Some mechanical factors of. Study I. Empty stomach and various ways of filling. Pressure exerted by gastric walls on gastric content. Physical changes occurring to foodstuffs during digestion (ab.), C. Gianturco, 512.
Gastrojejunal ulcer following gastro-enterostomy, Incidence of (ab.), J. W. Hinton and R. E. Church, 645.
Hypertonic and atonic colopathy, Syndrome of (ab.), F. H. Kruse, 511.
Importance of roentgen gastric functional study in differential diagnosis of pyloric lesions, W. H. Meyer, 206.
Increased irritability of gastro-intestinal tract: discussion of disturbed physiology, B. A. Rhinehart, 1.
Insufflation for roentgenologic diagnosis of gastric tumors, Importance of (ab.), F. Eisler, 647.
Intestinal invagination in children (ab.), L. O. Christensen, 641.
Intestinal invagination in children (ab.), J. Nordentoft, 642.
Polyposis in entire gastro-intestinal tract (ab.), C. Gütig and A. Herzog, 381.
Regional (terminal) ileitis: roentgen diagnosis (ab.), J. L. Kantor, 512.
Right upper abdominal pain, Radiological aspect of (ab.), L. J. Carter, 641.
Roentgen diagnosis of intermittent ileus (ab.), R. Prévôt, 381.
Roentgen localization of foreign bodies in stomach prior to gastroscopic removal, Method of (ab.), G. Tucker, 510.
Roentgenologic changes in transverse colon in peritoneal tuberculosis: case reports, J. Kaufman and I. Levine, 233.
Roentgenology, Debt of surgery to, D. C. Balfour, 684.
Roentgenologically demonstrable gastric mucosal atrophy in pernicious anemia, Concerning question of (ab.), R. Pape, 645.
Tumors of small intestine (ab.), T. M. Joyce, 641.
Unstable or irritable duodenum: clinical observations in 100 cases (ab.), J. Friedenwald and M. Feldman, 380.
X-ray experimental studies showing that rachitic rats with healed bone lesions continue to show alteration in their gastro-intestinal tract, L. J. Menville, J. N. Ané, and S. N. Blackberg, 74.
X-ray study of gastric rugæ, W. E. Pennington, 221.
GENITALS, abnormalities
Detailed anatomy of sella turcica and its clinical significance for recognition of size of hypophysis; contribution to study of relationship of size of hypophysis and size and form of sella turcica to anatomic and functional hypogenitalism (ab.), O. Bokelmann, 128.
GENITO-URINARY TRACT
Clinical value of bladder pressure estimations (ab.), K. H. Watkins, 253.
Excretion urography, Certain diagnostic phases of, A. E. Jones and R. A. Arens, 169.
Fatal gonococcal pyemia following internal urethrotomy (ab.), G. E. Parker, 513.
Granuloma of bladder (ab.), A. F. Weyerbacher and J. F. Balch, 514.
Hernia of bladder, Traumatic interstitial (ab.), R. J. White, 514.
Hydronephrosis due to aberrant blood vessel, Roentgenogram of (ab.), Jepkens and Loeweneck, 514.
Multiple urograms: aid in urological diagnosis, E. A. Baker and J. S. Lewis, Jr., 177.
Neglected affections and lesions of deep urethra (ab.), E. G. Ballenger, O. F. Elder, and H. P. McDonald, 253.
Postpartum pyrelitis of pregnancy: treatment of certain cases without use of ureteral catheter: explanation based on physiology of bladder (ab.), D. K. Rose, 382.
Pre-sacral sympathectomy and urinary bladder (ab.), E. D. McCrea and A. D. McDonald, 253.
Review of 162 consecutive personal cases of stone in upper urinary tract (ab.), H. P. Winsbury-White, 253.
Tuberculosis of urinary tract, with some evidence of spontaneous healing, Report of case of (ab.), J. Gray and S. T. Hsiu, 513.
Urologic problems in childhood, W. J. Engel, 183.
Uterosalpingography by interrupted fractional injections: modified and improved technic (ab.), M. N. Hyams, 642.
GOITER
Experiences in irradiation treatment of hyperthyroidism, S. P. Perry, 326.
Flajani-Basedow's disease, Roentgen therapy of (ab.), E. Jona, 514.
Hyperthyroidism by roentgen irradiation of pituitary gland, Treatment of, J. Borak, 535.

Radiologist and goiter problem (ab.), J. W. Cathcart, 760.
GRENZ RAYS
Biologic experiments with Grenz rays (ab.), F. Koch, 382.
GYNECOLOGY AND OBSTETRICS
Epispadias in women, Personal technic for cure of (ab.), O. Mercier, 515.
Experience with short wave therapy in gynecology, particularly in tumors of adnexa (ab.), E. Vogt, 253.
Placenta previa, Roentgenologic diagnosis of (ab.), W. H. Ude and J. A. Urner, 514.
Placenta prævia, Roentgen-ray diagnosis of, with report of two cases (ab.), J. Friedman and D. O. Macdonald, 642.
Tuberculosis of genital organs and peritoneum in women, Our method of roentgen therapy of (ab.), C. J. Gauss, 256.

HEART
Carditis and aortitis, Roentgen therapy of (ab.), B. Jegorow, 515.
Changes of cardiac contour and size, produced by increased intra-pulmonary pressure, investigated cardio-kymographically. (Cardio-kymograms during Valsalva experiments) (ab.), F. A. Nolte, 126.
Congenital cardiac disease in infants, with discussion of tracheal displacement as roentgen sign (ab.), E. P. Pendergrass and M. L. Allen, 515.
Coronary disease, Roentgen diagnosis of (ab.), G. Levene, F. E. Wheatley, and H. Matthews, 515.
Dilatation of pulmonary arch in roentgenologic cardiac silhouette: four cases of aneurysm of pulmonary artery (ab.), L. Holst, 642.
Esophagus in relation to heart, aorta, and thoracic cage, Study of, S. Brown and J. E. McCarthy, 131.
Graphical method for obtaining area of heart shadow in roentgen-ray study of heart disease, E. M. Van Buskirk, 433.
Myocardial calcification (ab.), J. J. Moore, 515.
HEMOPHILIA
Bone and joint changes in hemophilia (ab.), L. Solis-Cohen and S. Levine, 382.
Roentgen ray as aid in diagnosis of hemophilia (ab.), E. L. Rypins, 516.
HERNIA, diaphragmatic
Two cases of diaphragmatic hernia (ab.), J. S. Beilin, 252.
HIP JOINT
Fractures of neck of femur, dislocations of hip, and obscure vascular disturbances producing aseptic necrosis of head of femur (ab.), D. B. Phemister, 253.
HODGKIN'S DISEASE. *See* **Lymphogranuloma.**
HYDRONEPHROSIS
Roentgenogram of hydronephrosis due to aberrant blood vessel (ab.), Jepkens and Loeweneck, 514.
HYPERINSULINISM. *See under* **Pancreas, diseases.**
HYPERTENSION. *See* **Blood pressure, high.**
HYPOPHARYNX. *See* **Pharynx.**

INFANTS
Congenital cardiac disease in infants, with discussion of tracheal displacement as roentgen sign (ab.), E. P. Pendergrass and M. L. Allen, 515.
Congenital lung cysts in infants and children, S. G. Schenck and J. L. Stein, 420.
INFLAMMATION
Roentgen therapy in acute inflammatory diseases of mouth (ab.), R. K. Kruglikowa and S. N. Weissblatt, 382.
Roentgen therapy of pelvic inflammatory disease (ab.), A. Dapsy, 516.
INTESTINES. *See under* **Gastro-intestinal tract.**

KIDNEYS
Carbuncle of kidney (ab.), J. A. Lazarus, 254.
Congenital absence of one kidney (ab.), M. M. White, 516.
Echinococcus cyst attached to kidney: case report (ab.), M. J. Geyman and D. M. Clark, 516.
Excretion urography, Certain diagnostic phases of, A. E. Jones and R. A. Arens, 169.
Multiple urograms: aid in urological diagnosis, E. C. Baker and J. S. Lewis, Jr., 177.
Renal tuberculosis: plea for early diagnosis, C. J. Bucher and T. R. Fetter, 160.
Retrograde pyelography: description of routine procedure at Jefferson Medical College Hospital, T. R. Fetter and R. M. Smith, 555.
Unilateral urinary fistulas by x-ray destruction of kidney, Treatment of: clinical and experimental study (ab.), N. P. Sears, 383.
Urinary stone formation, Some newer conceptions of (ab.), J. D. Barney and E. R. Mintz, 377.
Urologic problems in childhood, W. J. Engel, 183.
tumors
Malignant tumors of kidney in children: with report of six cases, E. A. Pohle and G. Ritchie, 193.
Wilms tumor of kidney (ab.), S. J. Sinkoe, M. F. Fowler, and L. Berger, 255.

KNEE JOINT
Pneumoradiograms of knee joint (ab.), J. Oberholzer, 383.
tumors
Surgical treatment of benign tumors of knee joint by means of Juvara operation (ab.), I. Grigorescu and A. Vasiliu, 643.
KÖHLER'S DISEASE. *See* **Bones, diseases.**

LARYNX, cancer
Carcinoma of larynx and hypopharynx in Lund, Preliminary results obtained by teleradium therapy in, 1931–1933 (ab.), L. Edling, 639.
Evaluation of roentgen treatment of laryngeal carcinoma: report of cases, I. S. Hirsch and S. M. Baum, 281.
Radium treatment of carcinoma of vocal cords by "window" method (ab.), R. Müller, 645.
Treatment of carcinoma of pharynx and larynx, L. H. Garland, 261.
LEAD POISONING
Diagnosis of lead poisoning in children (ab.), M. Kasahara, 643.
LEUKEMIA
Irradiation in lymphosarcoma, Hodgkin's disease, and leukemia: statistical analysis (ab.), T. Leucutia, 126.
LIGHT THERAPY
Melanotic neoplasms of skin (ab.), S. W. Becker, 128.
LIGHT THERAPY. *See also* **Ultra-violet light.**
LIP, cancer
Carcinoma of lip, Roentgen therapy of, with short F.S.D. (ab.), H. Chaoul, 639.
Superficial malignancies, Irradiation treatment of (ab.), H. D. Kerr, 639.
LIVER
Perforated echinococcus of liver and spleen, Roentgenologic demonstration of (ab.), F. Berner and F. Meythaler, 643.
LUNGS
Bronchiectasis, Radiologic picture of (ab.), M. Belli, 516.
Bronchography, essential and safe adjunct in study of pulmonary tuberculosis (ab.), J. E. Murphy, 388.
Bronchography in relation to pathology of pulmonary tuberculosis (ab.), B. P. Potter, 388.
Bronchopulmonary segment, with special reference to putrid lung abscess (ab.), A. Glass, 385.
Carcinoma of bronchus or lung, Diagnosis and treatment of primary (ab.), E. A. Graham, 124.
Congenital cyst of lung, J. L. Dubrow, 480.
Congenital lung cysts in infants and children, S. G. Schenck and J. L. Stein, 420.
Degree of inspiration from chest film, Simple method for determining, K. D. A. Allen and H. D. Waltz, 225.
Force of gravity in pneumothorax cavity, Rôle of, including discussion of selective collapse, E. Korol, 550.
Initial tuberculous infection, Effect of, on subsequent tuberculous lesions (ab.), J. A. Myers and F. E. Harrington, 388.
Interlobar pneumothorax (ab.), R. Pohl, 640.
Lobectomy for pulmonary cancer, Elapse of three years without recurrence of cancer following: successful termination of pregnancy during free period (ab.), J. Divis, 638.
Lung abscess (ab.), H. Brunn, 383.
Lung tissue, Reaction of, to roentgen rays (ab.), R. B. Engelstad, 644.
Primary carcinoma of lung, Diagnosis of, C. H. Heacock and J. C. King, 452.
Pulmonary abscess in children, Diagnosis and treatment of (ab.), D. T. Smith, 255.
Pulmonary metastasis: pathologic, clinical, roentgenologic study based on 78 cases seen at necropsy, J. T. Farrell, Jr., 444.
Pulmonary tuberculosis, Hematogenous (non-miliary) (ab.), M. Pinner, 388.
Pulmonary tuberculosis, Round foci type of (ab.), S. Bruck, 388.
Round shadows in lungs (ab.), L. Udvardy, 384.
Serial bronchography for diagnosis of purulent diseases of lungs (ab.), P. L. Farinas, 384.
Syphilitic gumma of lung: case report (ab.), E. Freedman and C. S. Higley, 255.
LYMPHATIC SYSTEM
Management of cancer of mouth and cervical lymphatics (ab.), D. Quick, 377.
Roentgen study of absorption by lymphatics of thorax and diaphragm of thorium dioxide injected intrapleurally into animals (ab.), L. J. Menville and J. N. Ané, 256.
LYMPHOGRANULOMA
Hodgkin's disease, Five-year survival in (ab.), L. F. Craver, 126.
Irradiation in lymphosarcoma, Hodgkin's disease, and leukemia: statistical analysis (ab.), T. Leucutia, 126.
Treatment of lymphogranulomatosis with high doses of roentgen rays (ab.), F. Melchart, 760.

MASTOIDS
Mastoid processes, Roentgen examination of (ab.), F. M. Law, 516.
Roentgenologic diagnosis of mastoiditis (ab.), L. Kraus, 385.

MEDIASTINUM
Mediastinal pleurisy (ab.), L. Udvardy, 386.
Mediastinal tumors, Roentgen consideration of, W. A. Evans and E. R. Witwer, 463.
Mediastinal tumors, Roentgen diagnosis of, and their differentiation (ab.), G. E. Pfahler, 389.
MEDICINE, practice of
Health insurance, Compulsory, 368.
Proposed sickness insurance (ed.), W. L. Williamson, 632.
MEDICO-LEGAL
Encephalographic experiences: medico-legal deductions, E. S. Gurdjian and H. A. Jarre, 85.
How long are we liable? Physician sued for alleged fluoroscopic burn after sixteen years, I. S. Trostler, 500.
Shall we tell cancer patient truth? (ed.), F. A. Riebel, 496 (497).
Some remarks regarding medical expert witness and personal injury suit situation, I. S. Trostler, 567.
METATARSUS
Unilateral periosteal thickening of metatarsals (ab.), A. Zeitlin, 379.
MOUTH
Intra-oral cancer and its treatment, O. N. Meland, 276.
Management of cancer of mouth and cervical lymphatics (ab.), D. Quick, 377.
Nourishment in cases of radiological reaction in mucous membranes of mouth and throat (ab.), K. Palmstierna, 649.
Protracted external irradiation in treatment of neoplasms of mouth and throat: comparison of x-rays, 5-gram radium pack, and 100-milligram radium pack, M. Friedman and R. Rosh, 7.
Roentgen therapy in acute inflammatory diseases of mouth (ab.), R. K. Kruglikowa and S. N. Weissblatt, 382.

NERVOUS SYSTEM
Effect of roentgen rays on sympathetic nerves and adrenals in functional disturbances due to trauma (ab.), R. Desplats, 759.
Functional radiotherapy of sympathetic nerves and suprarenals in vasomotor sequels of trauma (ab.), R. Desplats, 759.
NOSE
Cured carcinoma of nose and antrum (ab.), M. H. Shutes, 638.

OBITUARIES
Duane, William, 372.
Duane, Professor William, contributions to radiology of, G. L. Clark, 499.
Henderson, Walter F., 756.
Paine, Robert, 757.
Pilcher, Lewis Stephen, 248.
OSTEITIS, deformans
Differential diagnosis of osteitis deformans (Paget's disease) and syphilis of bone (ab.), T. Canigiani and K. Singer, 376.
Juvenile osteitis deformans Paget, Two cases of (ab.), R. Hummel, 377.
Osteosarcoma in course of Paget's disease of bones (ab.), J. Haguenau, L. Gally, and P. Daum, 123.
Paget's disease as accidental finding (ab.), T. Barsony and K. Winkler, 376.
fibrosa
Osteodystrophia fibrosa unilateralis (ab.), K. Goldhamer, 123.
OSTEOGENESIS IMPERFECTA
Bone lesions in children, J. I. Mitchell, 715.
OSTEOMYELITIS
Bone lesions in children, J. I. Mitchell, 715.
Epithelialization of chronic osteomyelitic cavities: precancerous lesion, A. Brunschwig, 627.
Rhizomonomelorheostosis, B. P. Widmann and W. R. Stecher, 651.
OVARIES
Carcinoma of ovary, Our results in treatment of (ab.), C. Schroeder, 256.
Ovarian carcinoma, Value of irradiation in treatment of (ab.), J. H. Harris and F. L. Payne, 508, 639.

PAGET'S DISEASE OF BONES. *See* **Osteitis deformans.**
PANCREAS
Hyperinsulinism: three cases relieved by radiation, S. C. Barrow, 320.
Roentgen diagnosis of pancreatic cysts (ab.), J. Monauni, 644.
PARATHYROID
Roentgenographic studies of parathyroid deossification (ab.), J. J. Moore and A. A. de Lorimier, 376.
Urinary stone formation, Some newer conceptions of (ab.), J. D. Barney and E. R. Mintz, 377.
PARKINSON'S DISEASE
Parkinson's disease (ab.), N. Kiss and B. Szirmak, 517.
PELVIMETRY
Comparison of clinical and x-ray pelvimetry (ab.), N. H. Williams, 644.
Roentgen pelvimetry and fetal cephalometry: new technic: preliminary report, R. P. Ball and S. S. Marchbanks, 77.
Simplified mechanical method for radiographic mensuration and localization, H. E. Kimble, 39 (42).
PELVIS
Roentgen therapy of pelvic inflammatory disease (ab.), A. Dapsy, 516.
PEPTIC ULCER
Complications of peptic ulcer: prognostic significance (ab.), S. M. Jordan and E. D. Kiefer, 385.
Gastrojejunal ulcer following gastro-enterostomy, Incidence of (ab.), J. W. Hinton and R. E. Church, 645.
Perforated gastric and duodenal ulcers, Roentgenologic investigation of results of suturing of (ab.), A. Lob, 644.
PERITONEUM
Our method of roentgen therapy of tuberculosis of genital organs and peritoneum in women (ab.), C. J. Gauss, 256.
PHARYNX
Carcinoma of pharynx, Roentgen therapy of (ab.), H. Coutard, 508.
Carcinoma of pharynx and larynx, Treatment of, L. H. Garland, 261.
Symposium on treatment of pharyngeal cancer by divided or protracted dose principle of external radiation (ed.), H. E. Martin and M. Lenz, 364.
hypopharynx
Teleradium therapy in carcinoma of larynx and hypopharynx, Preliminary results obtained by, in Lund, 1931–1933 (ab.), L. Edling, 639.
PHLEBITIS
Sclerosis of peripheral veins (ab.), H. Kapp, 643.
PHYSICO-CHEMICAL EFFECTS
Physico-chemical effect of roentgen rays on organism (ab.), G. D. Lieber, 759.
PIGMENTATION
Spectrophotometric studies on human skin with special consideration of determination of degree of erythema and pigmentation (ab.), H. G. Bode, 128.
PITUITARY BODY. *See* **Endocrine glands.**
PLACENTA, prævia
Roentgen-ray diagnosis of placenta prævia, with report of two cases (ab.), J. Friedman and D. O. Macdonald, 642.
Roentgenologic diagnosis of placenta previa (ab.), W. H. Ude and J. A. Urner, 514.
PLEURISY
Mediastinal pleurisy (ab.), L. Udvardy, 386.
PNEUMOTHORAX
Artificial pneumothorax (ab.), J. A. Myers, 759.
Force of gravity in pneumothorax cavity, Rôle of: including discussion of selective collapse, E. Korol, 550.
Interlobar pneumothorax (ab.), R. Pohl, 640.
PROSTATE
Progress, indications, technic, and successful results of radiotherapy in prostatic hypertrophy, I. Gonzalez-Martinez, 66.
Roentgen treatment of benign hypertrophy of prostate gland (ab.), B. S. Barringer, A. L. Dean, Jr., R. E. Herendeen, and J. J. Duffy, 256.
Sarcoma of prostate (ab.), O. S. Lowsley and F. N. Kimball, 517.
Sarcoma of prostate cured by roentgen therapy, Case of (ab.), L. Popp, 386.
PYELOGRAPHY
Certain diagnostic phases of excretion urography, A. E. Jones and R. A. Arens, 169.
Multiple urograms: aid in urological diagnosis, E. A. Baker and J. S. Lewis, Jr., 177.
Retrograde pyelography: description of routine procedure at Jefferson Medical College Hospital, T. R. Fetter and R. M. Smith, 555.
Review of 162 consecutive personal cases of stone in upper urinary tract (ab.), H. P. Winsbury-White, 253.
Urologic problems in childhood, W. J. Engel, 183.
PYEMIA
Fatal gonococcal pyemia following internal urethrotomy (ab.), G. E. Parker, 513.
PYLORUS
Importance of roentgen gastric functional study in differential diagnosis of pyloric lesions, W. H. Meyer, 206.

RADIATION, burns and injuries
Benign stricture of intestine due to irradiation of carcinoma of cervix uteri (ab.), E. N. Collins and T. E. Jones, 254.
effects
Alteration in p_H of blood in cancer following roentgen and gamma irradiation (ab.), J. W. Schoonover, E. H. Shiels, and B. P. Widmann, 378.
Cytologic study of living body irradiated with hard ray. Pt. I. Influence of hard ray upon development of beans and abnormality of nuclei and cell division (ab.), T. Saito, 127.
Epilation of rabbit skin following irradiation (ab.), G. H. Klövekorn, 386.
Fibrinogen content of blood under influence of roentgen irradiation and primary effect of radiation (ab.), A. Held and H. Hülbach, 386.
Fundamental principles of pre-operative irradiation (ab.), O. Jüngling, 257.
Influence of roentgen rays on blood sugar in man, Studies regarding (ab.), K. Brochner-Mortensen, 650.

Physico-chemical effect of roentgen rays on organism (ab.), G. D. Lieber, 759.
Roentgen rays on yeast fermentation, Experimental studies concerning effect of (ab.), V. Gronchi, 126.
Short and ultra-short electric waves, Effect of, on inorganic and organic compounds (ab.), E. Hasché and H. Leunig, 517.
Volume-increase of bacteria from x-ray irradiation, T. J. Dietz, 31.

therapy
Chemotherapy as supplementary treatment in radiation therapy of malignant disease (ab.), F. Nahmmacher, 125.
Radiotherapy in problem of malignancy, Rôle of (ab.), E. E. Shepley, 639.
Vaginal fistulæ in patients with carcinoma of cervix, Incidence of (ab.), F. R. Smith, 125.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Annual meeting (1934), 245, 247.
Annual meeting (1935), 371.
Insurance Committee report, 247.
Radiologists-Hospitals Committee report, 245.

RADIOLOGY, practice of
Future of radiology, G. U. Pillmore, 749.
Radiologist as physician (ed.), F. Hernaman-Johnson, 116–121.
Fee tables and roentgenologists, E. Keating, 370.
Radiology as aid to general practitioner (ab.), E. K. Le Fleming, 257.

RADIUM
Alterations in *p*H of blood in cancer following roentgen and gamma irradiations (ab.), J. W. Schoonover, E. H. Shiels, and B. P. Widmann, 378.
Cancer of mouth and cervical lymphatics, Management of (ab.), D. Quick, 377.
Cancer of palatine tonsil and pillars, Radium therapy of (ab.), A. S. d'Emidio, 127.
Cancers of rectum, Contribution to technic of radium application in (ab.), E. Hesse, 646.
Cancers of uterine cervix, Histological classification of, and relation between growth structure and results of radium treatment (ab.), H. Chambers, 649.
Carcinoma of bladder, Use of radium in (ab.), A. J. D. Smith, 127.
Carcinoma of breast, Simultaneous radium and roentgen therapy of (ab.), F. Melchart and W. Schloss, 507.
Carcinoma of larynx and hypopharynx, Preliminary results obtained by teleradium therapy in, in Lund, 1931–1933 (ab.), L. Edling, 639.
Carcinoma of nose and antrum, Cured (ab.), M. H. Shutes, 638.
Carcinoma of vocal cords by "window" method, Radium treatment of (ab.), R. Müller, 645.
Complications following radium therapy of tumors of bladder and neighboring organs (ab.), W. I. Korchow, 127.
Cytologic study of living body irradiated with hard ray. Part I. Influence of hard ray upon development of beans and abnormality of nuclei and cell division (ab.), T. Saito, 127.
Dosimetry of radium rays, Contribution to (ab.), P. Dumont, 517.
Epithelioma involving cartilage, Treatment of, using 220 K.V.P. and heavy filtration, E. A. Merritt and R. R. Rathbone, 701.
Field of application for radium (ab.), R. Stewart-Harrison, 127.
Histological classification of cancers of uterine cervix and relation between growth structure and results of radium treatment (ab.), H. Chambers, 508.
Human skin, Permeability of, for radium emanation in air (ab.), G. Lang, 647.
Isodose curves in r, Determination of radium; corrections based on new experimental studies (ab.), F. Keller, 760.
Lobectomy for pulmonary cancer, Elapse of three years without recurrence of cancer following: successful termination of pregnancy during free period (ab.), J. Divis, 638.
Malignant diseases, Preliminary or pre-operative and pre-radium irradiation in management of, J. T. Stevens, 739.
Malignant tumors of upper respiratory tract, radium therapy in: results based on five years' observations (ab.), A. Lang, 386.
Measurement of beta rays of radium in r units (ab.), H. Smereker and K. Juris, 646.
Protracted external irradiation, Comparison of different technics in, M. Friedman, 630.
Protracted external irradiation in treatment of neoplasms of mouth and throat: comparison of x-rays, 5-gram radium pack, and 100-milligram radium pack, M. Friedman and R. Rosh, 7.
Radiation therapy at Michael Reese Hospital and Edward Hines Hospital, 497.
Radium dosimetry, Problem of (ab.), W. Friedrich, 127.
Radon ingestion and possible health dangers (ab.), H. H. Barker, 517.
Simultaneous multiple field irradiation with 4.5-gram radium pack, M. C. Reinhard and H. L. Goltz, 315.
Skin cancer and its cure, Stubborn (ab.), A. Hintze, 124.
Standardization in practical dosage in roentgen and radium therapy, Advances in (ab.), T. C. Neeff, 379.
Sterilization of radium and mesothorium needles for surgical purposes (ab.), W. Gericke and H. Leunig, 517.
Supplementary radium treatment in roentgen therapy of uterine carcinoma (ab.), H. Wintz, 260.
Symposium on treatment of pharyngeal cancer by divided or protracted dose principle of external radiation (ed.), H. E. Martin and M. Lenz, 364.
Uterus, Treatment of erosions of, with roentgen and radium rays (ab.), A. J. Kuratschenkow, 390.

apparatus
Semi-automatic implant-cutter, W. Stenstrom and C. E. Nurnberger, 562.

emanation ointment
Successful treatment of radiation injuries of skin (ab.), E. Uhlmann and G. Schambye, 638.

irradiation injury
Benign stricture of intestine due to irradiation of carcinoma of cervix uteri (ab.), E. N. Collins and T. E. Jones, 254.

RECTUM, cancer
Radium application in cancers of rectum, Contribution to technic of (ab.), E. Hesse, 646.

RESPIRATORY TRACT
Dyspnea (ab.), J. C. Meakins, 518.

RICKETS, experimental
X-ray examination studies showing that rachitic rats with healed bone lesions continue to show alteration in their gastro-intestinal tract, L. J. Menville, J. N. Ané, and S. N. Blackberg, 74.

ROENTGEN RAYS, apparatus
Mensuration and localization, Simplified mechanical method for radiographic, H. E. Kimble, 39.
Radio frequency high voltage apparatus for x-ray therapy, R. S. Stone, M. S. Livingston, D. H. Sloan, and M. A. Chaffee, 153, 298.
Radiographic mensuration and localization, Simplified mechanical method for, H. E. Kimble, 39.
Roentgen pelvimetry and fetal cephalometry: new technic: preliminary report, R. P. Ball and S. S. Marchbanks, 77.
Serial films with Potter-Bucky diaphragm, Simple method of making, W. O. Weiskotten, 625.
Serial radiography and demonstration of mucosal relief in gastro-intestinal examinations, Apparatus for, J. C. Bell, 143.
Sinus-mastoid and gastro-duodenal radiography, Composite unit for, W. W. Robinson, 235.
Spectrographic method of measuring voltage wave form of roentgen tube, R. R. Newell, 165.
Technic for use of small cone in check radiographs of spine, G. R. Pearson, 601.

biological effects
Susceptibility of *Drosophila* eggs to x-rays, Changes in. II. Correlation of biological activity and radiosensitivity, P. S. Henshaw, 438.

burns and injuries
Successful treatment of radiation injuries of skin (ab.), E. Uhlmann and G. Schambye, 638.

dosage
Construction of small ionization chambers without directional effect and their use in roentgen dosimetry (ab.), P. Rosenfeld and F. Melchart, 640.
Dosage conditions in technic of roentgen treatment used in Sweden, Experimental investigations of some (ab.), R. Thoraeus, 640.
Dosage factors, 371.
Measurements of distribution of roentgen rays for short focal distances (ab.), H. W. Ernst, K. Frik, and P. Ott, 759.
Protracted external irradiation in treatment of neoplasms of mouth and throat: comparison of x-rays, 5-gram radium pack, and 100-milligram radium pack, M. Friedman and R. Rosh, 7.
Roentgen-ray standards and units. Standardizing procedure of national laboratories, 509.
Standardization of practical dosage in roentgen and radium therapy, Advances in (ab.), T. C. Neeff, 379.
Variations in dosage dependent on wave length (ab.), M. C. Reinhard, 509.
Volume-increase of bacteria from x-ray irradiation, T. J. Dietz, 31.
X-ray dosis and rate of mutation, Relation between (ab.), K. G. Zimmer, 126.

examination
Absorption by lymphatics of thorax and diaphragm of thorium dioxide injected intrapleurally into animals, Roentgen study of (ab.), L. J. Menville and J. N. Ané, 256.
Appendix, Pathological (ab.), J. Felsen, 376.
Area of heart shadow in roentgen-ray study of heart disease. Graphical method for obtaining, E. M. Van Buskirk, 433.
Benign tumors of stomach (ab.), M. Simonsen, 387.
Biliary colic fistula, H. B. Podlasky, 345.
Bone lesions in children, J. I. Mitchell, 715.
Bone sarcoma, with remarks concerning "osteo-arthropathie hypertrophiante pneumique," Contribution to etiology and roentgen diagnosis of (ab.), J. Palugyay, 123.
Bronchiectasis, Radiologic picture of (ab.), M. Belli, 516.
Bronchography, essential and safe adjunct in study of pulmonary tuberculosis (ab.), J. E. Murphy, 388.
Bronchography in relation to pathology of pulmonary tuberculosis (ab.), B. P. Potter, 388.
Bronchography, Simplified method of, J. Forestier and L. Leroux, 743.
Bronchopulmonary segment, with special reference to putrid lung abscess (ab.), A. Glass, 385.

ROENTGEN RAYS, examination—continued
Calcification of splenic artery, J. E. Heatley, 235.
Cancer metastatic to bone, W. A. Fort, 96.
Carbuncle of kidney (ab.), J. A. Lazarus, 254.
Carcinoma of duodenum, Primary: case report (ab.), P. C. Swenson and A. G. Levin, 378.
Carcinoma of small intestine, Early diagnosis of (ab.), K. Hohenner, 377.
Carcinoma of stomach in girl 21 years of age, W. J. MacFarland, 494.
Carcinoma of stomach, Modification of radiation treatment of, I. I. Kaplan, 735.
Cardiac contour and size, Changes of, produced by increased intra-pulmonary pressure, investigated cardiokymographically. (Cardio-kymograms during Valsalva experiments) (ab.), F. A. Nolte, 126.
Cardiac disease in infants, Congenital, with discussion of tracheal displacement as roentgen sign (ab.), E. P. Pendergrass and M. L. Allen, 515.
Cholecystographic diagnosis: management and technic for oral cholecystography, D. S. Beilin, 218.
Chronic appendicitis, Roentgenologic diagnosis of (ab.), A. Bejul and L. Holst, 637.
Chronic appendicitis, Spontaneous (ab.), M. Cerf, 637.
Chronic arthritis, Roentgen diagnosis of, H. P. Doub, 391.
Colon, Roentgen diagnosis of diseases of: evaluation of methods (ab.), H. M. Weber, 513.
Colon studies: VII. Variations in fixation of cecocolon; clinical significance (ab.), J. L. Kantor and S. Schechter, 510.
Colonic lesion, W. H. McGuffin, 114.
Congenital atrophy of thumb, Two cases of: reconstruction by bone graft (ab.), C. Parisel, 637.
Congenital cyst of lung, J. L. Dubrow, 480.
Congenital lung cysts in infants and children, S. G. Schenck and J. L. Stein, 420.
Coronary disease, Roentgen diagnosis of (ab.), G. Levene, F. E. Wheatley, and H. Matthews, 515.
Degree of inspiration from chest film, Simple method for determining, K. D. Allen and H. D. Waltz, 225.
Diaphragmatic hernia, Two cases of (ab.), J. S. Beilin, 252.
Diverticula of stomach (ab.), A. B. Rivers, G. A. Stevens, and B. R. Kirklin, 647.
Dorsum sella, fracture of: report of case, M. L. Allen, 111.
Duodenitis and roentgenologic characteristics (ab.), B. R. Kirklin, 512.
Encephalographic experiences: medico-legal deductions, E. S. Gurdjian and H. A. Jarre, 85.
Endothelial myeloma: analysis of cases (ab.), W. C. Campbell, 258.
Epithelialization of chronic osteomyelitic cavities: precancerous lesion, A. Brunschwig, 627.
Esophagus, Disturbed peristalsis of, with formation of pseudo-diverticula (ab.), J. Palugyay and G. Pesek, 509.
Esophagus in relation to heart, aorta, and thoracic cage, Study of, S. Brown and J. E. McCarthy, 131.
Excretion urography, Certain diagnostic phases of, A. E. Jones and R. A. Arens, 169.
Extensive malignant lesions of stomach, Treatment of (ab.), W. Walters, 519.
Familial bony dystrophy with multiple exostoses, H. A. Yenikomshian and H. K. Blake, 623.
Force of gravity in pneumothorax cavity, Rôle of: including discussion of selective collapse, E. Korol, 550.
Foreign bodies in stomach prior to gastroscopic removal, Method of roentgen localization of (ab.), G. Tucker, 510.
Fractures of neck of femur, dislocations of hip, and obscure vascular disturbances producing aseptic necrosis of head of femur (ab.), D. B. Phemister, 253.
Fundus of stomach, Diverticula of, L. W. Paul, 47.
Gall bladder, Diverticulum of (ab.), J. H. Vastine, 510.
Gallstones and their diagnosis in gall bladder not filled by dye (ab.), E. A. Zimmer, 380.
Gas gangrene of extremity, Importance of roentgenologic examination for diagnosis and treatment of (ab.), J. Schneider, 380.
Gastric cancer, Some phases of roentgenologic diagnosis of (Carman Lecture), B. R. Kirklin, 672.
Gastric rugæ, X-ray study of, W. E. Pennington, 221.
Gastric tumors, Importance of insufflation for roentgenologic diagnosis of (ab.), F. Eisler, 647.
Gastro-intestinal tract: discussion of disturbed physiology, Increased irritability of, B. A. Rhinehart, 1.
Gastro-intestinal tract, Polyposis in entire (ab.), C. Gütig and A. Herzog, 381.
Hemophilia, Bone and joint changes in (ab.), L. Solis-Cohen and S. Levine, 382.
Hemophilia, Roentgen ray as aid in diagnosis of (ab.), E. L. Rypins, 516.
Histological studies of liver, spleen, and bone marrow in rabbits following intravenous injection of thorium dioxide (ab.), E. A. Pohle and G. Ritchie, 378.
Hydronephrosis due to aberrant blood vessel, Roentgenogram of (ab.), Jepkens and Loeweneck, 514.
Hypertonic and atonic colopathy, Syndrome of (ab.), F. H. Kruse, 511.
Ileitis, Regional (terminal): roentgen diagnosis (ab.), J. L. Kantor, 512.
Ileus, Roentgen diagnosis of intermittent (ab.), R. Prévôt, 381.
Inflammation of descending portion of duodenum: preliminary report, M. L. Sussman, 691.
Intestinal invagination in children (ab.), L. O. Christensen, 641.
Intestinal tuberculosis: pathologic and roentgenologic observations (ab.), R. L. Boles and J. Gershon-Cohen, 387.
Intestines, Foreign bodies in (ab.), C. Jackson and C. L. Jackson, 640.
Initial tuberculous infection, Effect of, on subsequent tuberculous lesions (ab.), J. A. Myers and F. E. Harrington, 388.
Interpretation of chest radiographs, notes on, with particular reference to tuberculosis (ab.), T. G. Hardman, 129.
Intervertebral discs, Clinical importance of, with special reference to nuclear prolapses (ab.), G. B. Bush, 129.
Iodized oil in cases of intractable asthma, Diagnostic and therapeutic value of intratracheal use of, with special reference to its use as contrast medium and physicochemical mechanism on which its therapeutic value is based, R. M. Balyeat, L. E. Seyler, and H. A. Shoemaker, 303.
Irritable colon syndrome, C. J. Laus, 572.
Kaschin-Beck's disease, Roentgen symptomatology of (ab.), W. Graziansky, 638.
Knee joint, Pneumoradiograms of (ab.), J. Oberholzer, 383.
Köhler's disease, Some reflections on etiology of, A. Zeitlin, 360.
Lead poisoning in children, Diagnosis of (ab.), M. Kasahara, 643.
Lung abscess (ab.), H. Brunn, 383.
Lungs, Round shadows in (ab.), L. Udvardy, 384.
Luxation of semilunar bone, Radiologic study of (ab.), E. Ingber, 520.
Mastoid processes, Roentgen examination of (ab.), F. M. Law, 516.
Mastoiditis, Roentgenologic diagnosis of (ab.), L. Kraus, 385.
Mediastinal and intraspinal perineural fibroblastoma (hourglass or dumb-bell tumor) removed by one-stage operation (ab.), S. W. Harrington and W. McK. Craig, 760.
Mediastinal tumors, Roentgen consideration of, W. A. Evans and E. R. Witwer, 463.
Mediastinal tumors, Roentgen diagnosis of, and their differentiation (ab.), G. E. Pfahler, 389.
Multiple urograms: aid in urological diagnosis, E. C. Baker and J. S. Lewis, Jr., 177.
Myocardial calcification (ab.), J. J. Moore, 515.
Oblique view for demonstration of articular facets in lumbosacral backache and sciatic pain (ab.), R. K. Ghormley and B. R. Kirklin, 257.
Optic canals, Simple technic for radiography of (ab.), C. Fava, 510.
Os acetabuli (ab.), E. Freedman, 507.
Osteitis tuberculosa multiplex cystica, with report of two cases, J. H. Vastine and E. P. Bacon, 22.
Osteogenesis imperfecta: report of two cases (ab.), S. Kleinberg, 252.
Osteogenic sarcoma: roentgenologic characteristics, R. T. Wilson, 708.
Osteosarcoma in course of Paget's disease of bones (ab.), J. Haguenau, L. Gally, and P. Daum, 123.
Paget's disease as accidental finding (ab.), T. Barsony and K. Winkler, 376.
Parathyroid deossiffication, Roentgenographic studies of (ab.), J. J. Moore and A. A. de Lorimier, 376.
Pelvimetry, Comparison of clinical and x-ray (ab.), N. H. Williams, 644.
Perforated echinococcus of liver and spleen, Roentgenologic demonstration of (ab.), F. Berner and F. Meythaler, 643.
Perforated gastric and duodenal ulcers, Roentgenologic investigation of results of suturing of (ab.), A. Lob, 644.
Petrous bone in auditory nerve tumors, Results of examination of (ab.), B. Ebenius, 259.
Placenta prævia, Roentgen-ray diagnosis of, with report of two cases (ab.), J. Friedman and D. O. Macdonald, 642.
Placenta previa, Roentgenologic diagnosis of (ab.), W. H. Ude and J. A. Urner, 514.
Primary carcinoma of lung, Diagnosis of, C. H. Heacock and J. C. King, 452.
Pseudarthrosis of leg, Congenital: three cases treated by massive bone graft (ab.), P. C. Colonna, 506.
Pulmonary abscess in children, Diagnosis and treatment of (ab.), D. T. Smith, 255.
Pulmonary arch in roentgenologic cardiac silhouette, Dilatation of: four cases of aneurysm of pulmonary artery (ab.), L. Holst, 642.
Pulmonary consolidation in tuberculous patients (epituberculosis), Specificity of: resolution of experimental tuberculous pneumonia (ab.), H. S. Willis, 519.
Pulmonary metastasis: pathologic, clinical, roentgenologic study based on 78 cases seen at necropsy, J. T. Farrell, Jr., 444.
Pulmonary tuberculosis, Hematogenous (non-miliary) (ab.), M. Pinner, 388.
Pulmonary tuberculosis, management of: study of 500 cases, Productive lesion in, C. C. Birkelo and S. M. Gelenger, 58.
Pulmonary tuberculosis, Round foci type of (ab.), S. Bruck, 388.
Renal tuberculosis: plea for early diagnosis, C. J. Bucher and T. R. Fetter, 160.
Retrograde pyelography: description of routine procedure at Jefferson Medical College Hospital, T. R. Fetter and R. M. Smith, 555.

Rhizomonomelorheostosis, B. P. Widmann and W. R. Stecher, 651.
Right upper abdominal pain, Radiological aspect of (ab.), L. J. Carter, 641.
Pancreatic cysts, Roentgen diagnosis of (ab.), J. Monauni, 644.
Roentgen diagnostic problem in chronic appendicitis, Solution of: conclusions based upon studies covering period of twenty years and including comparative analysis of roentgenological, clinical, surgical, and postmortem findings (ab.), T. Scholz, 505.
Roentgen gastric functional study in differential diagnosis of pyloric lesions, Importance of, W. H. Meyer, 206.
Roentgen-ray consideration in injury cases (ab.), W. S. Greenleaf, 650.
Roentgenologically demonstrable gastric mucosal atrophy in pernicious anemia, Concerning question of (ab.), R. Pape, 645.
Roentgenology, Debt of surgery to, D. C. Balfour, 684.
Saliography, Technic of (ab.), E. Simon, 518.
Schüller-Christian disease after x-ray therapy, living and under observation eleven years, M. B. Radding, 591.
Serial bronchography for diagnosis of purulent diseases of lungs (ab.), P. L. Farinas, 384.
Serial films with Potter-Bucky diaphragm, Simple method of making, W. O. Weiskotten, 625.
Serial radiography and demonstration of mucosal relief in gastro-intestinal examinations, Apparatus for, J. C. Bell, 143.
Sinus-mastoid and gastro-duodenal radiography, Composite unit for, W. W. Robinson, 235.
Sphenoids (1,000) examined in both Granger and mento-vertex positions, A. Granger, 357.
Stone in upper urinary tract, Review of 162 consecutive personal cases (ab.), H. P. Winsbury-White, 253.
Surgery as adjunct to treatment of arthritis, W. C. Campbell, 398.
Susceptibility of *Drosophila* eggs to x-rays, Changes in. II. Correlation of biological activity and radiosensitivity, P. S. Henshaw, 438.
Sympathetic neuroblastoma; with report of two cases, Roentgen aspects of, A. Hartung and S. R. Rubert, 607.
Syphilitic gumma of lung: case report (ab.), E. Freedman and C. S. Higley, 255.
Testis, Tumors of (ab.), A. U. Desjardins, 520.
Transverse colon in peritoneal tuberculosis: Roentgenologic changes in, case reports, J. Kaufman and I. Levine, 233.
Tuberculous and non-tuberculous pulmonary infections in infancy and childhood (ab.), F. M. McPhedran, 129.
Tuberculous lesions in children of school age (ab.), H. W. Hetherington, 129.
Tumors of small intestine (ab.), T. M. Joyce, 641.
Tumors of thorax, Extra-pulmonary, C. B. Peirce, 467.
Ununited intracapsular fractures of femoral neck roentgenographically considered (ab.), A. W. George and R. D. Leonard, 379.
Urologic problems in childhood, W. J. Engel, 183.
Uterosalpingography by interrupted fractional injections: modified and improved technic (ab.), M. N. Hyams, 642.
Uterus, Aid in determining position of, J. M. Keichline, 238.
Varices of esophagus (ab.), G. Wachner, 640.
Ventriculography in diagnosis of intracranial tumor (ab.), L. C. E. Lindon, 649.
Xanthomatosis involving bone (lipoid histiocytosis): case reports and roentgen findings, L. A. Smith, 521.
X-ray experimental studies showing that rachitic rats with healed bone lesions continue to show alteration in their gastro-intestinal tract, L. J. Menville, J. N. Ané, and S. N. Blackberg, 74.

films
Artefacts in roentgen films, G. C. Henny, 350.

filters
Filtration in Coutard method, Purposes and significance of (ab), J. Jovin, 639.

sickness
"Peremesin" for prevention of x-ray sickness (ab.), H. Kuhn, 386.
X-ray sickness, Cause and treatment of (ab.), F. G. Dietel and V. Probst, 645.

therapy
Agranulocytic leukopenia: report of case successfully treated with x-rays, and some observations on effect of amidopyrine (ab.), J. E. Benjamin and J. B. Biederman, 376.
Alterations in P_H of blood in cancer following roentgen and gamma irradiation (ab.), J. W. Schoonover, E. H. Shiels, and B. P. Widmann, 378.
Basophilic adenoma (pituitary basophilism): report of case, with clinical improvement of systemic manifestations after irradiation of pituitary, M. G. Wohl, J. R. Moore, and B. R. Young, 53.
Benign hypertrophy of prostate gland, Roentgen treatment of (ab.), B. S. Barringer, A. L. Dean, Jr., R. E. Herendeen, and J. J. Duffy, 256.
Blood, Roentgen therapy of diseases of (ab.), R. Pape, 637.
Blood sugar of rabbits, Influence of roentgen irradiation on, and suitability for blood sugar experiments (ab.), J. Engelbreth-Holm, 509.
Bone sarcoma, Roentgen therapy of (ab.), K. Goldhamer, 389.
Cancer, Social and economic aspects of, A. Soiland, 213.
Cancer therapy with extremely hard roentgen rays, preliminary report concerning our three years' experience in (ab.), E. v. Schubert, 124.
Carcinoma, Hyperintensive irradiation of certain types of: preliminary report (ab.), H. Lammers, 508.
Carcinoma of breast, Simultaneous radium and roentgen therapy of (ab.), F. Melchart and W. Schloss, 507.
Carcinoma of cervix, Intravaginal irradiation at close range of (ab.), H. Martius, 260.
Carcinoma of cervix, Results in treatment of, by Women's Clinic of University of Breslau (ab.), W. Reiprich, 390.
Carcinoma of fundus uteri and of post-menopausal metrorrhagia, Roentgen therapy of (ab.), P. Gibert and L. Solomon, 507.
Carcinoma of lip with short F.S.D., Roentgen therapy of (ab.), H. Chaoul, 639.
Carcinoma of ovary, Results in treatment of (ab.), C. Schroeder, 256.
Carcinoma of pharynx, Roentgen therapy of (ab.), H. Coutard, 508.
Carcinoma of pharynx and larynx, Treatment of, L. H. Garland, 261.
Carcinoma of stomach, Modification of radiation treatment of, I. I. Kaplan, 735.
Carcinoma of uterus, Combination of radiation therapy with chemotherapy in (ab.), L. Havlasek, 639.
Carditis and aortitis, Roentgen therapy of (ab.), B. Jegorow, 515.
Coutard's method of treating cancer by irradiation therapy (ed.), 364.
Cyst of iris, Roentgen therapy of post-traumatic (ab.), M. Lüdin and A. Bader, 379.
Epitheliolysis, with special consideration of oral, pharyngeal, and laryngeal carcinomas, Radiotherapeutic significance of (ab.), J. Borak, 252.
Epithelioma involving cartilage, Treatment of, using 220 K.V.P. and heavy filtration, E. A. Merritt and R. R. Rathbone, 701.
Epithelioma of cheek, Treatment of, G. E. Pfahler, 99.
Erysipelas, Roentgen therapy of (ab.), C. Kruchen, 640.
Ewing's sarcoma, Treatment of: results in Zürich (ab.), R. Stewart-Harrison, 646.
Fibrinogen content of blood under influence of roentgen irradiation and primary effect of radiation (ab.), A. Held and H. Hülbach, 386.
Filtration in Coutard method, Purposes and significance of (ab.), J. Jovin, 639.
Flajani-Basedow's disease, Roentgen therapy of (ab.), E. Jona, 514.
Functional disturbances due to trauma, Effect of roentgen rays on sympathetic nerves and adrenals in (ab.), R. Desplats, 759.
Functional radiotherapy of sympathetic nerves and suprarenals in vasomotor sequels of trauma (ab.), R. Desplats, 759.
Hemangio-endothelioma and susceptibility to irradiation (ab.), R. Baumann-Schenker, 519.
Hodgkin's disease, Five-year survival in (ab.), L. F. Craver, 126.
Hyperinsulinism: three cases relieved by radiation, S. C. Barrow, 320.
Hypertension and diabetes, Radiotherapeutic treatment of, J. H. Hutton, 330.
Hyperthyroidism by roentgen irradiation of pituitary gland, Treatment of, J. Borak, 535.
Hyperthyroidism, Experiences in irradiation treatment of, S. P. Perry, 326.
Inflammatory diseases of mouth, acute, Roentgen therapy in (ab.), R. K. Kruglikowa and S. N. Weissblatt, 382.
Intestinal invagination in children (ab.), J. Nordentoft, 642.
Intra-oral cancer and its treatment, O. N. Meland, 276.
Laryngeal carcinoma, Evaluation of roentgen treatment of: report of cases, I. S. Hirsch and S. M. Baum, 281.
Loss of r units following x-ray treatment, Simple method for estimating, W. J. Young and J. Love, 110.
Lung abscess (ab.), H. Brunn, 383.
Lung tissue, Reaction of, to roentgen rays (ab.), R. B. Engelstad, 644.
Lymphogranulomatosis with high doses of roentgen rays, Treatment of (ab.), F. Melchart, 760.
Lymphosarcoma, Hodgkin's disease, and leukemia; statistical analysis, Irradiation in (ab.), T. Leucutia, 126.
Lymphosarcoma of stomach and cure by roentgen therapy (ab.), R. Kaiser, 259.
Lymphosarcoma of stomach, Diagnosis of (ab.), O. Spitzerberger, 387.
Malignant diseases, Preliminary or pre-operative and pre-radium irradiation in management of, J. T. Stevens, 739.
Malignant intrathoracic tumors, Irradiation treatment of (ab.), F. G. Chandler, N. S. Finzi, and J. Maxwell, 259.
Malignant tumors of kidney in children, E. A. Pohle and G. Ritchie, 193.
Malignant tumors of upper respiratory tract, Radium therapy in: results based on five years' observations (ab.), A. Lang, 386.
Malignant tumors, Problem of treatment of (ab.), P. Buisson, 519.
Malignant tumors, Roentgen therapy of metastases of (ab.), H. Herzum, 649.
Non-malignant disease of tonsils in over 1,000 patients, Ten years' experience with roentgen therapy in (ab.), G. Schulte, 258.

ROENTGEN RAYS, therapy—continued
Osteitis deformans Paget, Two cases of juvenile (ab.), R. Hummel, 377.
Osteogenic sarcoma: pathologic characteristics, C. Phillips, 728.
Ovarian carcinoma, Value of irradiation in treatment of (ab.), J. H. Harris and F. L. Payne, 508, 639.
Parkinson's disease (ab.), N. Kiss and B. Szirmak, 517.
Pelvic inflammatory disease, Roentgen therapy of (ab.), A. Dapsy, 516.
Primary carcinoma of bronchus or lung, Diagnosis and treatment of (ab.), E. A. Graham, 124.
Prostatic hypertrophy, Progress, indications, technic, and successful results of radiotherapy in, I. Gonzalez-Martinez, 66.
Protracted external irradiation, Comparison of different technics in, M. Friedman, 630.
Radiation therapy at Michael Reese Hospital and Edward Hines Hospital, 497.
Radiological reaction in mucous membranes of mouth and throat, Nourishment in cases of (ab.), K. Palmstierna, 649.
Radiotherapy, physical therapy, and hyperpyrexia in treatment of arthritic disturbances, Relative value of, J. C. King, 411.
Roentgen therapy, Data concerning three years' experience with 600 K.V. (peak) (ab.), S. G. Mudd, C. K. Emery, O. N. Meland, and W. E. Costolow, 507.
Roentgen therapy through small fields in deep-seated tumors (ab.), A. Kukowka, 125.
Roentgen therapy with voltages above 200 K.V., Present status of: technical development and medical application (ab.), T. Leucutia and K. E. Corrigan, 506.
Round-cell sarcoma: experience at x-ray laboratory of University of Zürich, 1919–1934 (ab.), R. Baumann-Schenker, 520.
Sarcoma of prostate cured by roentgen therapy, Case of (ab.), L. Popp, 386.
Schüller-Christian disease after x-ray therapy, living and under observation eleven years, M. B. Radding, 591.
Seminoma, Contribution to problem of radiation therapy in (ab.), A. Gilliard, 649.
Short wave therapy in gynecology, particularly tumors of adnexa, Experience with (ab.), E. Vogt, 253.
"Sieve" radiation (ab.), W. Haring, 128.
Skin and mucous membrane, Reactions in, following protracted roentgen therapy (ab.), R. Sarasin, 518.
Skin cancer, Stubborn, and cure (ab.), A. Hintze, 124.
Superficial malignancies, Irradiation treatment of (ab.), H. D. Kerr, 639.
Surgical treatment of benign tumors of knee joint by means of Juvara operation (ab.), I. Grigorescu and A. Vasiliu, 643.
Symposium on treatment of pharyngeal cancer by divided or protracted dose principle of external radiation (ed.), H. E. Martin and M. Lenz, 364.
Syringomyelia by x-rays, Treatment of (ab.), E. M. Haworth, 648.
Syringomyelia, Roentgen therapy in, F. W. O'Brien, 16.
Teleradium therapy with roentgen rays, Attempt to imitate (ab.), E. Ebbehoj, 639.
Teratoma testis, Studies in diagnosis and treatment of (ab.), R. S. Ferguson, 389.
Testis, Tumors of (ab.), A. U. Desjardins, 520.
Therapy with short electric waves (ab.), E. Schliephake, 650.
Thyrotoxicosis, Observations on irradiated cases of (ab.), W. Lahm, 258.
Tonsillitis, Roentgen therapy of (ab.), E. D. Dubowyi and E. I. Olschanowskyi, 519.
Tuberculosis of genital organs and peritoneum in women, Method of roentgen therapy of (ab.), C. J. Gauss, 256.
Urinary fistulas, Treatment of unilateral, by x-ray destruction of kidney: clinical and experimental study (ab.), N. P. Sears, 383.
Uterine carcinoma, Development of radiation therapy of (ab.), A. Lacassagne, 260.
Uterine carcinoma, Radiation therapy of (ab.), F. Voltz, 260.
Uterine carcinoma, Supplementary radium treatment in roentgen therapy of (ab.), H. Wintz, 260.
Uterus, Treatment of erosions of, with roentgen and radium rays (ab.), A. J. Kuratschenkow, 390.
Wilms tumor of kidney (ab.), S. J. Sinkoe, M. F. Fowler, and L. Berger, 255.
X-ray experimental studies showing that rachitic rats with healed bone lesions continue to show alteration in their gastro-intestinal tract, L. J. Menville, J. N. Ané, and S. N. Blackberg, 74.
Yeast fermentation, Experimental studies concerning effect of roentgen rays on (ab.), V. Gronchi, 126.
tubes
Spectrographic method of measuring voltage wave form of roentgen tube, R. R. Newell, 165.

SALIVARY GLANDS
Saliography, [*sic*] technic of (ab.), E. Simon, 518.
Sialolithiasis of maxillary glands (ab.), Q. Vischia, 252.
SARCOMA
Bone sarcoma, Contribution to etiology and roentgen diagnosis of, with remarks concerning "osteo-arthropathie hypertrophiante pneumique" (ab.), J. Palugyay, 123.
Bone sarcoma, Roentgen therapy in (ab.), K. Goldhamer, 389.
Bone sarcoma, Studies in. III. Experimental and pathological study of rôle of periosteum in formation of bone in various bone tumors (ab.), A. Brunschwig and P. H. Harmon, 646.
Endothelial myeloma: analysis of cases (ab.), W. C. Campbell, 258.
Ewing's sarcoma, Treatment of: results in Zürich (ab.), R. Stewart-Harrison, 646.
Osteogenic sarcoma: pathologic characteristics, C. Phillips, 728.
Osteogenic sarcoma: roentgenologic characteristics, R. T. Wilson, 708.
Osteosarcoma in course of Paget's disease of bones (ab.), J. Haguenau, L. Gally, and P. Daum, 123.
Round-cell sarcoma: experience at x-ray laboratory of University of Zürich, 1919–1934 (ab.), R. Baumann-Schenker, 520.
Sarcoma of prostate (ab.), O. S. Lowsley and F. N. Kimball, 517.
Sarcoma of prostate cured by roentgen therapy, Case of (ab.), L. Popp, 386.
lymphosarcoma
Irradiation in lymphosarcoma, Hodgkin's disease, and leukemia: statistical analysis (ab.), T. Leucutia, 126.
Lymphosarcoma of stomach and its cure by roentgen therapy (ab.), R. Kaiser, 259.
Lymphosarcoma of stomach, Diagnosis of (ab.), O. Spitzenberger, 387.
SCIATICA
Oblique view for demonstration of articular facets in lumbosacral backache and sciatic pain (ab.), R. K. Ghormley and B. R. Kirklin, 257.
SCHULLER-CHRISTIAN SYNDROME
Schüller-Christian disease after x-ray therapy, living and under observation eleven years, M. B. Radding, 591.
Xanthomatosis involving bone (lipoid histiocytosis): case reports and roentgen findings, L. A. Smith, 521.
SCLEROSIS
Sclerosis of peripheral veins (ab.), H. Kapp, 643.
SCURVY
Bone lesions in children, J. I. Mitchell, 715.
SELLA TURCICA
Detailed anatomy of sella turcica and its clinical significance for recognition of size of hypophysis; contribution to study of relationship of size of hypophysis and size and form of sella turcica to anatomic and functional hypogenitalism (ab.), O. Bokelmann, 128.
Fracture of dorsum sella: report of case, M. L. Allen, 111.
SEMILUNAR BONE
Radiologic study of luxation of semilunar bone (ab.), E. Ingber, 520.
SINUSES, nasal
Anomalies in position of planum sphenoidale and diagnostic significance (ab.), E. G. Mayer, 518.
Sphenoids (1,000) examined in both Granger and mento-vertex positions, A. Granger, 357.
SKIN
Epilation of rabbit skin following irradiation (ab.), G. H. Klövekorn, 386.
Melanotic neoplasms of skin (ab.), S. W. Becker, 128.
Permeability of human skin for radium emanation in air (ab.), G. Lang, 647.
Reactions in skin and mucous membrane following protracted fractional roentgen therapy (ab.), R. Sarasin, 518.
Regional variations in skin reaction (ab.), J. Borak, 518.
"Sieve" radiation (ab.), W. Haring, 128.
Spectrophotometric studies on human skin with special consideration of determination of degree of erythema and pigmentation (ab.), H. G. Bode, 128.
cancer
Epithelioma involving cartilage, Treatment of, using 220 K.V.P. and heavy filtration, E. A. Merritt and R. R. Rathbone, 701.
Stubborn skin cancer and its cure (ab.), A. Hintze, 124.
wounds and injuries
Successful treatment of radiation injuries of skin (ab.), E. Uhlmann and G. Schambye, 638.
SOCIETIES
American Board of Radiology, 121, 240–245.
Florida State Radiological Society, 248.
Indiana Roentgen Society, 498.
Italian Congresses, 249, 501.
Los Angeles County Medical Association: Radiological Section, 248.
Minnesota Radiological Society, 248, 633.
Pan-American Medical Association, 371, 633.
Royal Society of Edinburgh (award), 372.
Southern Surgical Congress (Surgeons to meet in Jacksonville, Florida), 121.
SPECTROPHOTOMETRY
Spectrophotometric studies on human skin with special consideration of determination of degree of erythema and pigmentation (ab.), H. G. Bode, 128.
SPINE
Clinical importance of intervertebral discs, with special reference to nuclear prolapses (ab.), G. B. Bush, 129.
Oblique view for demonstration of articular facets in lumbosacral backache and sciatic pain (ab.), R. K. Ghormley and B. R. Kirklin, 257.

SPLEEN
Perforated echinococcus of liver and spleen, Roentgenologic demonstration of (ab.), F. Berner and F. Meythaler, 643.
STOMACH
Benign tumors of stomach (ab.), M. Simonsen, 387.
Carcinoma of stomach in girl 21 years of age, W. J. MacFarland, 494.
Carcinoma of stomach, Modification of radiation treatment of, I. I. Kaplan, 735.
Cascade stomach (ab.), W. Kaufmann, 257.
Extensive malignant lesions of stomach, Treatment of (ab.), W. Walters, 519.
Gastric cancer, Some phases of roentgenologic diagnosis of (Carman Lecture), B. R. Kirklin, 672.
Lymphosarcoma of stomach, Diagnosis of (ab.), O. Spitzenberger, 387.
Mechanical factors of gastric physiology, Some. Study I. Empty stomach and its various ways of filling. Pressure exerted by gastric walls on gastric content. Physical changes occurring to foodstuff during digestion (ab.), C. Gianturco, 512.
Mechanical factors of gastric physiology, Some. Study II. Pyloric mechanism—effect of various foods on emptying of stomach (ab.), C. Gianturco, 512.
Multiple diverticula in cardiac end of stomach (ab.), K. Kremser, 387.
Roentgen localization of foreign bodies in stomach prior to gastroscopic removal, Method of (ab.), G. Tucker, 510.
Roentgenologic investigation of results of suturing of perforated gastric and duodenal ulcers (ab.), A. Lob, 644.
Roentgenologically demonstrable gastric mucosal atrophy in pernicious anemia, Concerning question of (ab.), R. Pape, 645.
X-ray study of gastric rugæ, W. E. Pennington, 221.
diverticula
Diverticula of fundus of stomach, L. W. Paul, 47.
Diverticula of stomach (ab.), A. B. Rivers, G. A. Stevens, and B. R. Kirklin, 647.
sarcoma
Lymphosarcoma of stomach and its cure by roentgen therapy (ab.), R. Kaiser, 259.
tumors
Insufflation for roentgenologic diagnosis of gastric tumors, Importance of (ab.), F. Eisler, 647.
SUPRARENALS
Effect of roentgen rays on sympathetic nerves and adrenals in functional disturbances due to trauma (ab.), R. Desplats, 759.
Functional radiotherapy of sympathetic nerves and suprarenals in vasomotor sequels of trauma (ab.), R. Desplats, 759.
SYPHILIS
Bone lesions in children, J. I. Mitchell, 715.
Differential diagnosis of osteitis deformans (Paget's disease) and syphilis of bone (ab.), T. Canigiani and K. Singer, 376.
Syphilitic gumma of lung: case report (ab.), E. Freedman and C. S. Higley, 255.
SYRINGOMYELIA
Roentgen therapy in syringomyelia, F. W. O'Brien, 16.
Syringomyelia by x-rays, Treatment of (ab.), E. M. Haworth, 648.

TEMPORAL BONE
Results of examination of petrous bone in auditory nerve tumors (ab.), B. Ebenius, 259.
TESTES
Function of testes after puberty (ab.), T. E. Hammond, 258.
Multiple fibromas of tunica vaginalis (ab.), G. Gordon-Taylor, 519.
tumor
Testis, Tumors of (ab.), A. U. Desjardins, 520.
THORAX
Esophagus in relation to heart, aorta, and thoracic cage, Study of, S. Brown and J. E. McCarthy, 131.
Extra-pulmonary tumors of thorax, C. B. Peirce, 467.
THROAT
Nourishment in cases of radiological reaction in mucous membranes of mouth and throat (ab.), K. Palmstierna, 649.
Protracted external irradiation in treatment of neoplasms of mouth and throat: comparison of x-rays, 5-gram radium pack, and 100-milligram radium pack, M. Friedman and R. Rosh, 7.
THYROID
Experiences in irradiation treatment of hyperthyroidism, S. P. Perry, 326.
Observations on irradiated cases of thyrotoxicosis (ab.), W. Lahm, 258.
Radiologist and goiter problem (ab.), J. W. Cathcart, 760.
TONSILS
Management of cancer of mouth and cervical lymphatics (ab.), D. Quick, 377.
Radium therapy of cancer of palatine tonsil and pillars (ab.), A. S. d'Emidio, 127.
Ten years' experience with roentgen therapy in non-malignant disease of tonsils in over 1,000 patients (ab.), G. Schulte, 258.
Tonsillitis, Roentgen therapy of (ab.), E. D. Dubowyi and E. I. Olschanowskyi, 519.

TUBERCULOSIS, intestinal
Intestinal tuberculosis: pathologic and roentgenologic observations (ab.), R. L. Boles and J. Gershon-Cohen, 387.
peritoneal
Roentgenologic changes in transverse colon in peritoneal tuberculosis: case reports, J. Kaufman and I. Levine, 233.
pulmonary
Artificial pneumothorax (ab.), J. A. Myers, 759.
Blood picture in pulmonary tuberculosis, especially relation between sedimentation and shifting to left (ab.), S. Cold, 648.
Bronchography, essential and safe adjunct in study of pulmonary tuberculosis (ab.), J. E. Murphy, 388.
Bronchography in relation to pathology of pulmonary tuberculosis (ab.), B. P. Potter, 388.
Initial tuberculous infection, Effect of, on subsequent tuberculous lesions (ab.), J. A. Myers and F. E. Harrington, 388.
Interpretation of chest radiographs, with particular reference to tuberculosis, Notes on (ab.), T. G. Hardman, 129.
Management of productive lesion in pulmonary tuberculosis: study of 500 cases, C. C. Birkelo and S. M. Gelenger, 58.
Pulmonary consolidation in tuberculous patients (epituberculosis), Specificity of; resolution of experimental tuberculous pneumonia (ab.), H. S. Willis, 519.
Pulmonary tuberculosis, Hematogenous (non-miliary) (ab.), M. Pinner, 388.
Pulmonary tuberculosis, Round foci type of (ab.), S. Bruck, 388.
Renal tuberculosis: plea for early diagnosis, C. J. Bucher and T. R. Fetter, 160.
Tuberculous and non-tuberculous pulmonary infections in infancy and childhood (ab.), F. M. McPhedran, 129.
Tuberculous lesions in children of school age (ab.), H. W. Hetherington, 129.
renal
Renal tuberculosis: plea for early diagnosis, C. J. Bucher and T. R. Fetter, 160.
Tuberculosis of urinary tract, with some evidence of spontaneous healing, Report of case of (ab.), J. Gray and S. T. Hsiu, 513.
TUMORS
Bone sarcoma, Studies in. III. Experimental and pathological study of rôle of periosteum in formation of bone in various primary bone tumors (ab.), A. Brunschwig and P. H. Harmon, 646.
Extra-pulmonary tumors of thorax, C. B. Peirce, 467.
Malignant tumors, Roentgen therapy of metastases of (ab.), H. Herzum, 649.
Surgical treatment of benign tumors of knee joint by means of Juvara operation (ab.), I. Grigorescu and A. Vasiliu, 643.
Tumors of small intestine (ab.), T. M. Joyce, 641.
Ventriculography in diagnosis of intracranial tumor (ab.), L. C. E. Lindon, 649.
acoustic
Results of examination of petrous bone in auditory nerve tumors (ab.), B. Ebenius, 259.
benign
Benign tumors of stomach (ab.), M. Simonsen, 387.
diagnosis
Gastric tumors, Importance of insufflation for roentgenologic diagnosis of (ab.), F. Eisler, 647.
Mediastinal tumors, Roentgen diagnosis of, and their differentiation (ab.), G. E. Pfahler, 389.
Ewing's
Bone sarcoma, Studies in. III. Experimental and pathological study of rôle of periosteum in formation of bone in various primary bone tumors (ab.), A. Brunschwig and P. H. Harmon, 646.
Ewing's sarcoma, Treatment of: results in Zürich (ab.), R. Stewart-Harrison, 648.
fibroma
Multiple fibromas of tunica vaginalis (ab.), G. Gordon-Taylor, 519.
fibroblastoma
Mediastinal and Intraspinal perineural fibroblastoma (hourglass or dumb-bell tumor) removed by one-stage operation (ab.), S. W. Harrington and W. McK. Craig, 760.
granuloma
Granuloma of bladder (ab.), A. F. Weyerbacher and J. F. Balch, 514.
hemangio-endothelioma
Hemangio-endothelioma and susceptibility to irradiation (ab.), R. Baumann-Schenker, 519.
melanoma
Melanotic neoplasms of skin (ab.), S. W. Becker, 128.
Endothelial myelome: analysis of cases (ab.), W. C. Campbell, 258.
neuroblastoma
Sympathetic neuroblastoma: with report of two cases, Roentgen aspects of, A. Hartung and S. R. Rubert, 607.
of kidneys
Malignant tumors of kidney in children: with report of six cases, E. A. Pohle and G. Ritchie, 193.
Urologic problems in childhood, W. J. Engel, 183 (190).
seminoma
Radiation therapy in seminoma, Contribution to problem of (ab.), A. Gilliard, 649.

TUMORS—continued
teratoma
Teratoma testis, Studies in diagnosis and treatment of (ab.), R. S. Ferguson, 389.
therapy
Basophilic adenoma (pituitary basophilism): report of case, with clinical improvement of systemic manifestations after irradiation of pituitary, M. G. Wohl, J. R. Moore, and B. R. Young, 53.
Experience with short wave therapy in gynecology, particularly in tumors of adnexa (ab.), E. Vogt, 253.
Fundamental principles of pre-operative irradiation (ab.), O. Jüngling, 257.
Influence of ultra-short electrical waves on malignant tumors (ab.), E. Hasché and W. A. Collier, 124.
Irradiation treatment of malignant intrathoracic tumors (ab.), F. G. Chandler, N. S. Finzi, and J. Maxwell, 259.
Malignant tumors, Problem of treatment of (ab.), P. Buisson, 519.
Radium therapy in malignant tumors of upper respiratory tract: results based on five years' observations (ab.), A. Lang, 386.
Roentgen consideration of mediastinal tumors, W. A. Evans and E. R. Witwer, 463.
Roentgen therapy through small fields in deep-seated tumors (ab.), A. Kukowka, 125.
Testis, Tumors of (ab.), A. U. Desjardins, 520.
Wilms' tumor
Malignant tumors of kidney in children: with report of six cases, E. A. Pohle and G. Ritchie, 193.
Wilms tumor of kidney (ab.), S. J. Sinkoe, M. F. Fowler, and L. Berger, 255.

ULTRA-VIOLET LIGHT
Influence of sunlight on the red blood corpuscles of man *in vivo* (ab.), W. W. Lepeschkin, 130.
Usefulness of decomposition of H_2O_2 as a measuring reaction in ultra-violet light dosimetry (ab.), H. Sostmann, 130.
URETER
Urologic problems in childhood, W. J. Engel, 183.
URETHRA
Neglected affections and lesions of deep urethra (ab.), E. G. Ballenger, O. F. Elder, and H. P. McDonald, 253.
UROGRAPHY. *See* **Pyelography.**
UROLOGY
Certain diagnostic phases of excretion urography, A. E. Jones and R. A. Arens, 169.
Multiple urograms: aid in urological diagnosis, E. C. Baker and J. S. Lewis, Jr., 177.
Urologic problems in childhood, W. J. Engel, 183.
Symposium on, 169–205.
UTERUS
Benign stricture of intestine due to irradiation of carcinoma of cervix uteri (ab.), E. N. Collins and T. E. Jones, 254.
Cancers of uterine cervix, Histological classification of, and relation between growth structure and results of radium treatment (ab.), H. Chambers, 508, 649.
Carcinoma of cervix, Results in treatment of, by Women's Clinic of University of Breslau (ab.), W. Reiprich, 390.
Carcinoma of cervix, Incidence of vaginal fistulæ in patients with (ab.), F. R. Smith, 125.
Carcinoma of cervix, Intravaginal irradiation at close range of (ab.), H. Martius, 260.
Carcinoma of fundus uteri and of post-menopausal metrorrhagia, Roentgen therapy of (ab.), P. Gibert and L. Solomon, 507.
Carcinoma of uterus, Combination of radiation therapy with chemotherapy in (ab.), L. Havlasek, 639.
Erosions of uterus with roentgen and radium rays, Treatment of (ab.), A. J. Kuratschenkow, 390.
Uterine carcinoma, Development of radiation therapy of (ab.), A. Lacassagne, 260.
Uterine carcinoma, Radiation therapy of (ab.), F. Voltz, 260.
Uterine carcinoma, Supplementary radium treatment in roentgen therapy of (ab.), H. Wintz, 260.
Uterosalpingography by interrupted fractional injections: modified and improved technic (ab.), M. N. Hyams, 642.
retroflexion
Aid in determining position of uterus, J. M. Keichline, 238.

VAGINA, fistula
Incidence of vaginal fistulæ in patients with carcinoma of cervix (ab.), F. R. Smith, 125.
VASOMOTOR SYSTEM
Effect of roentgen rays on sympathetic nerves and adrenals in functional disturbances due to trauma (ab.), R. Desplats, 759.
Functional radiotherapy of sympathetic nerves and suprarenals in vasomotor sequels of trauma (ab.), R. Desplats, 759.
VEINS
Sclerosis of peripheral veins (ab.), H. Kapp, 643.
VOCAL CORDS. *See* **Larynx.**

WRIST
Hereditary synostoses of small bones of hand and foot: hereditary *os tibiale externum* (ab.), J. Mestern, 390.
Luxuation of semilunar bone, Radiologic study of (ab.), E. Ingber, 520.

YEAST
Yeast fermentation, Experimental studies concerning effect of roentgen rays on (ab.), V. Gronchi, 126.

AUTHORS

ALLEN, KENNETH D. A., and WALTZ, HAROLD D., with HANNER, DOROTHY D., Simple method for determining degree of inspiration from chest film, 225.
ALLEN, M. LOWRY, Fracture of dorsum sella: report of case, 111.
ALLEN, M. LOWRY, with PENDERGRASS, EUGENE P., jt. auth.
ANÉ, J. N., with MENVILLE, L. J., jt. auth.
ARENS, ROBERT A., with JONES, ALFRED E., jt. auth.

BACON, EMILY P., with VASTINE, JACOB H., jt. auth.
BADER, A., with LUDIN, M., jt. auth.
BAKER, EDGAR C., and LEWIS, JOHN S., Jr., Multiple urograms: aid in urological diagnosis, 177.
BALCH, JAMES F., with WEYERBACHER, A. F., jt. auth.
BALFOUR, DONALD C., Debt of surgery to roentgenology, 684.
BALL, ROBERT P., and MARCHBANKS, S. S., Roentgen pelvimetry and fetal cephalometry: new technic: preliminary report, 77.
BALLENGER, EDGAR G., ELDER, OMAR F., and McDONALD, HAROLD P. (ab.), Neglected affections and lesions of deep urethra, 253.
BALYEAT, RAY M., SEYLER, L. EVERETT, and SHOEMAKER, H. A., Diagnostic and therapeutic value of intratracheal use of iodized oil in cases of intractable asthma, with special reference to its use as contrast medium and physico-chemical mechanism on which its therapeutic value is based, 303.
BARKER, HOWARD H. (ab.), Radon ingestion and its possible health dangers, 517.
BARNEY, J. D., and MINTZ, E. R. (ab.), Some newer conceptions of urinary stone formation, 377.
BARRINGER, BENJAMIN S., DEAN, ARCHIE L., JR., HERENDEEN, RALPH E., and DUFFY, JAMES J. (ab.), Roentgen treatment of benign hypertrophy of prostate gland, 256.
BARROW, S. C., Hyperinsulinism: three cases relieved by radiation, 320.
BARSONY, T., and WINKLER, K. (ab.), Paget's disease as accidental finding, 376.
BAUM, SAMUEL M., with HIRSCH, I. SETH, jt. auth.
BAUMANN-SCHENKER, RUDOLF (ab.), Hemangio-endothelioma and susceptibility to irradiation, 519.
BAUMANN-SCHENKER, RUDOLF (ab.), Round-cell sarcoma: experience at x-ray laboratory of University of Zurich, 1919–1934, 520.
BECKER, S. WILLIAM (ab.), Melanotic neoplasms of skin, 128.
BEILIN, D. S., Cholecystographic diagnosis: management and technic for oral cholecystography, 218.
BEILIN, J. S. (ab.), Two cases of diaphragmatic hernia, 252.
BEJUL, A., and HOLST, L. (ab.), Roentgenologic diagnosis of chronic appendicitis, 637.
BELL, JOSEPH C., Apparatus for serial radiography and demonstration of mucosal relief in gastro-intestinal examinations, 143.
BELLI, MARIO (ab.), Radiologic picture of bronchiectasis, 516.
BENJAMIN, JULIEN E., and BIEDERMAN, JOSEPH B. (ab.), Agranulocytic leukopenia: report of case successfully treated with x-rays, and some observations on effect of amidopyrine, 376.
BERGER, LOUIS, see SINKOE, SAMUEL J., jt. auth.
BERGH, G. S., with IVY, A. C., jt. auth.
BERNER, F., and MEYTHALER, F. (ab.), Roentgenologic demonstration of perforated echinococcus of liver and spleen, 643.
BIEDERMAN, JOSEPH B., see BENJAMIN, JULIEN E., jt. auth.
BIRKELO, C. C., and GELENGER, S. M., Management of pro-

ductive lesion in pulmonary tuberculosis: study of 500 cases, 58.
BLACKBERG, S. N., with MENVILLE, L. J., jt. auth.
BLAKE, H. K., with YENIKOMSHIAN, H. A., jt. auth.
BODE, H. G. (ab.), Spectrophotometric studies on human skin, with special consideration of determination of degree of erythema and pigmentation, 128.
BOKELMANN, O. (ab.), Detailed anatomy of sella turcica and clinical significance for recognition of size of hypophysis; contribution to study of relationship of size of hypophysis and size and form of sella turcica to anatomic and functional hypogenitalism, 128.
BOLES, RUSSELL L., and GERSHON-COHEN, JACOB (ab.), Intestinal tuberculosis: pathologic and roentgenologic observations, 387.
BORAK, J. (ab.), Radiotherapeutic significance of epitheliolysis, with special consideration of oral, pharyngeal, and laryngeal carcinomas, 252.
BORAK, J. (ab.), Regional variations in skin reaction, 518.
BORAK, J., Treatment of hyperthyroidism by roentgen irradiation of pituitary gland, 535.
BOTH, ERICH (ab.), Saturation potentials in ionized gases, 650.
BRASCH, A., and LANGE, F. (ab.), Possibilities of high speed cathode rays in therapy, 125.
BROCHNER-MORTENSEN, K. (ab.), Studies regarding influence of roentgen rays on blood sugar in man, 650.
BROWN, SAMUEL, and McCARTHY, JUSTIN E., Study of esophagus in relation to heart, aorta, and thoracic cage, 131.
BRUCK, SAMUEL (ab.), Round foci type of pulmonary tuberculosis, 388.
BRUNSCHWIG, ALEXANDER, Epithelialization of chronic osteomyelitic cavities: pre-cancerous lesion, 627.
BRUNSCHWIG, ALEXANDER, and HARMON, PAUL H. (ab.), Studies in bone sarcoma.—III. Experimental and pathological study of rôle of periosteum in formation of bone in various primary bone tumors, 646.
BRUNN, HAROLD (ab.), Lung abscess, 383.
BUCHER, CARL J., and FETTER, THEODORE, R., Renal tuberculosis: plea for early diagnosis, 160.
BUISSON, PAOLO (ab.), Problem of treatment of malignant tumors, 519.
BUSH, GILBERT B. (ab.), Clinical importance of intervertebral discs, with special reference to nuclear prolapses, 129.

CAMPBELL, WILLIS C. (ab.), Endothelial myeloma: analysis of cases, 258.
CAMPBELL, WILLIS C., Surgery as adjunct to treatment of arthritis, 398.
CANIGIANI, T., and SINGER, K. (ab.), Differential diagnosis of osteitis deformans (Paget's disease) and syphilis of bone, 376.
CAPUA, ANTONIO (ab.), Some studies on mechanism of rapid cholecystography, 510.
CARTER, L. J. (ab.), Radiological aspect of right upper abdominal pain, 641.
CATHCART, J. W. (ab.), Radiologist and goiter problem, 760.
CECIL, RUSSEL L. (ab.), Medical treatment of chronic arthritis, 505.
CERF, MAURICE (ab.), Spontaneous chronic appendicitis, 637.
CHAFFEE, MILTON A., see STONE, ROBERT S., jt. auth.
CHAMBERS, H. (ab.), Histological classification of cancers of uterine cervix and relation between growth structure and results of radium treatment, 508, 649.
CHANDLER, F. G., FINZI, N. S., and MAXWELL, JAMES (ab.), Irradiation treatment of malignant intrathoracic tumors, 259.
CHAOUL, H. (ab.), Roentgen therapy of carcinoma of lip with short F.S.D., 639.
CHRISTENSEN, L. OSTERGAARD (ab.), Intestinal invagination in children, 641.
CHURCH, REYNOLD E., with HINTON, J. WILLIAM, jt. auth.
CLARK, D. M., with GEYMAN, M. J., jt. auth.
CLARK, GEORGE L., Contributions to radiology of Professor William Duane, 499.
COLD, SIGURD (ab.), Blood picture in pulmonary tuberculosis, especially relation between sedimentation and shifting to left, 648.
COLLIER, W. A., with HASCHÉ, E., jt. auth.
COLLINS, E. N., and JONES, THOMAS E. (ab.), Benign stricture of intestine due to irradiation of carcinoma of cervix uteri, 254.
COLONNA, PAUL C. (ab.), Congenital pseudarthrosis of leg: three cases treated by massive bone graft, 506.
CORRIGAN, K. E., with LEUCUTIA, T., jt. auth.
COSTOLOW, WILLIAM E., with MUDD, SEELEY G., jt. auth.
COUNSELLER, VIRGIL S., with DESJARDINS, ARTHUR U., jt. auth.
COUTARD, H. (ab.), Roentgen therapy of carcinoma of pharynx, 508.
CRAIG, WINCHELL McK., with HARRINGTON, STUART W., jt. auth.
CRAVER, LLOYD F. (ab.), Five-year survival in Hodgkin's disease, 126.

DAPSY, ANDREAS (ab.), Roentgen therapy of pelvic inflammatory disease, 516.
DAUM, P., with HAGUENAU, J., jt. auth.
DEAN, ARCHIE L., JR., see BARRINGER, BENJAMIN S., jt. auth.
de LORIMIER, ALFRED A., with MOORE, JOHN J., jt. auth.
DESJARDINS, ARTHUR U., COUNSELLER, VIRGIL S., and GIANTURCO, CESARE (ab.), Tumors of testis, 520.
DESPLATS, R. (ab.), Effect of roentgen rays on sympathetic nerves and adrenals in functional disturbances due to trauma, 759.
DESPLATS, R. (ab.), Functional radiotherapy of sympathetic nerves and suprarenals in vasomotor sequels of trauma, 759.
DIETEL, F. G., and PROBST, V. (ab.), Cause and treatment of x-ray sickness, 645.
DIETZ, THOMAS J., Volume-increase of bacteria from x-ray irradiation, 31.
DIVIS, J. (ab.), Elapse of three years without recurrence of cancer following lobectomy for pulmonary cancer: successful termination of pregnancy during free period, 638.
DIXON, CLAUDE E. (ab.), Carcinoma of cecum: what are chances of cure? 378.
DOUB, HOWARD P., Roentgen diagnosis of chronic arthritis, 391.
DUBOWYI, E. D., and OLSCHANOWSKYI, E. I. (ab.), Roentgen therapy of tonsilitis, 519.
DUBROW, JAMES L., Congenital cyst of lung, 480.
DUFFY, JAMES J., see BARRINGER, BENJAMIN S., jt. auth.
DUMONT, P. (ab.), Contribution to dosimetry of radium rays, 517.

EBBEHOJ, ERIK (ab.), Attempt to imitate teleradium therapy with roentgen rays, 639.
EBENIUS, BERTIL, Results of examination of petrous bone in auditory nerve tumors, 259.
EDLING, LARS (ab.), Preliminary results obtained by teleradium therapy in carcinoma of larynx and hypopharynx, in Lund, 1931–1933, 639.
EISLER, FRITZ (ab.), Importance of insufflation for roentgenologic diagnosis of gastric tumors, 647.
ELDER, OMAR F., see BALLENGER, EDGAR G., jt. auth.
EMERY, CLYDE K., with MUDD, SEELEY G., jt. auth.
d'EMIDIO, ANGELO SANTORO (ab.), Radium therapy of cancer of palatine tonsil and pillars, 127.
ENGEL, WILLIAM J., Urologic problems in childhood, 183.
ENGELBRETH-HOLM, J. (ab.), Influence of roentgen irradiation on blood sugar of rabbits and their suitability for blood sugar experiments, 509.
ENGELSTAD, ROLF B. (ab.), Have cosmic rays demonstrable biologic effects? 379.
ENGELSTAD, ROLF B. (ab.), Reaction of lung tissue to roentgen rays, 644.
ERNST, H. W., FRIK, KARL, and OTT, PAUL (ab.), Measurements of distribution of roentgen rays for short focal distances, 759.
EVANS, WILLIAM A., and WITWER, E. R., Roentgen consideration of mediastinal tumors, 463.

FARINAS, PEDRO L. (ab.), Serial bronchography for diagnosis of purulent diseases of lungs, 384.
FARRELL, JOHN T., JR., Pulmonary metastasis: phathologic, clinical, roentgenologic study based on 78 cases seen at necropsy, 444.
FAVA, CESARE (ab.), Simple technic for radiography of optic canals, 510.
FELDMAN, MAURICE, with FRIEDENWALD, JULIUS, jt. auth.
FELSEN, JOSEPH (ab.), Pathological appendix, 376.
FERGUSON, RUSSELL S. (ab.), Studies in diagnosis and treatment of teratoma testis, 389.
FETTER, THEODORE R., and SMITH, R. MANGES, Retrograde pyelography: description of routine procedure at Jefferson Medical College Hospital, 555.
FETTER, THEODORE R., with BUCHER, CARL J., jt. auth.
FINZI, N. S., see CHANDLER, F. G., jt. auth.
FORESTIER, JACQUES, and LEROUX, LOUIS, Simplified method of bronchography, 743.
FORT, WALTER, A., Cancer metastatic to bone, 96.
FOWLER, MAJOR F., see SINKOE, SAMUEL J., jt. auth.
FREEDMAN, EUGENE (ab.), Os acetabuli, 507.
FREEDMAN, EUGENE, and HIGLEY, CHARLES S. (ab.), Syphilitic gumma of lung: case report, 255.
FRIEDENWALD, JULIUS, and FELDMAN, MAURICE (ab.), Unstable or irritable duodenum: clinical observations in 100 cases, 380.
FRIEDMAN, J., and MacDONALD, D. O. (ab.), Roentgen-ray diagnosis of placenta prævia, with report of two cases, 642.
FRIEDMAN, MILTON, Comparison of different technics in protracted external irradiation, 630.
FRIEDMAN, MILTON, and ROSH, RIEVA, Protracted external irradiation in treatment of neoplasms of mouth and throat: comparison of x-rays, 5-gram radium pack, and 100-milligram radium pack, 7.
FRIEDRICH, W. (ab.), Problem of radium dosimetry, 127.
FRIK, KARL, with ERNST, H. W., jt. auth.

GALLY, L., with HAGUENAU, J., jt. auth.
GARLAND, L. H., Treatment of carcinoma of pharynx and larynx, 261.

GAUSS, C. J. (ab.), Our method of roentgen therapy of tuberculosis of genital organs and peritoneum in women, 256.
GELENGER, S. M., with BIRKELO, C. C., jt. auth.
GENTNER, W., and SCHMIDT-LA BAUME, F. (ab.), Studies of biologic effect of cathode rays, 125.
GEORGE, ARIAL W., and LEONARD, RALPH D. (ab.), Ununited intracapsular fractures of femoral neck roentgenographically considered, 379.
GERICKE, W., and LEUNIG, H. (ab.), Sterilization of radium and mesothorium needles for surgical purposes, 517.
GERSHON-COHEN, JACOB, with BOLES, RUSSELL L., jt. auth.
GEYMAN, M. J., and CLARK, D. M. (ab.), Echinococcus cyst attached to kidney: case report, 516.
GHORMLEY, RALPH K., and KIRKLIN, B. R. (ab.), Oblique view for demonstration of articular facets in lumbosacral backache and sciatic pain, 257.
GIANTURCO, CESARE (ab.), Some mechanical factors of gastric physiology. Study I. Empty stomach and various ways of filling. Pressure exerted by gastric walls on gastric content. Physical changes occurring to foodstuff during digestion, 512.
GIANTURCO, CESARE (ab.), Some mechanical factors of gastric physiology. Study II. Pyloric mechanism—effect of various foods on emptying of stomach, 512.
GIANTURCO, CESARE, with DESJARDINS, ARTHUR U., jt. auth.
GIBERT, P., and SOLOMON, L. (ab.), Roentgen therapy of carcinoma of fundus uteri and of post-menopausal metrorrhagia, 507.
GILLIARD, ANDRÉ (ab.), Contribution to problem of radiation therapy in seminoma, 649.
GLASS, AMEIL (ab.), Bronchopulmonary segment, with special reference to putrid lung abscess, 385.
GLOCKER, R., KUGLER, G. A., and LANGENDORFF, H. (ab.), Radiobiological experiments undertaken as basis for use of high speed cathode rays in therapy, 125.
GOLDHAMER, KARL (ab.), Osteodystrophia fibrosa unilateralis, 123.
GOLDHAMER, K. (ab.), Roentgen therapy of bone sarcoma, 389.
GOLTZ, H. L., see REINHARD, M. C., jt. auth.
GONZALEZ-MARTINEZ, I., Progress, indications, technic, and successful results of radiotherapy in prostatic hypertrophy, 66.
GORDON-TAYLOR, G. (ab.), Multiple fibromas of tunica vaginalis, 519.
GRAHAM, EVARTS A. (ab.), Diagnosis and treatment of primary carcinoma of bronchus or lung, 124.
GRANGER, AMÉDÉE, One thousand sphenoids examined in both Granger and mento-vertex positions, 357.
GRAY, J., and HSIU, S. T. (ab.), Report of case of tuberculosis of urinary tract, with some evidence of spontaneous healing, 513.
GRAZIANSKY, W. (ab.), Roentgen symptomatology of Kaschin-Beck's disease, 638.
GREENLEAF, WILLIAM S. (ab.), Roentgen-ray consideration in injury cases, 650.
GRIGORESCU, I., and VASILIU, ALEXANDER (ab.), Surgical treatment of benign tumors of knee joint by means of Juvara operation, 643.
GRONCHI, V. (ab.), Experimental studies concerning effect of roentgen rays on yeast fermentation, 126.
GURDJIAN, E. S., and JARRE, H. A., Encephalographic experiences: medico-legal deductions, 85.
GÜTIG, C., and HERZOG, A. (ab.), Polyposis in entire gastrointestinal tract, 381.

HAGUENAU, J., GALLY, L., and DAUM, P. (ab.), Osteosarcoma in course of Paget's disease of bones, 123.
HAMMOND, T. E. (ab.), Function of testes after puberty, 258.
HANNER, DOROTHY D., see ALLEN, KENNETH D. A.
HARDMAN, T. GARRATT (ab.), Notes on interpretation of chest radiographs, with particular reference to tuberculosis, 129.
HARING, W. (ab.), "Sieve" radiation, 128.
HARMON, PAUL H., with BRUNSCHWIG, ALEXANDER, jt. auth.
HARRINGTON, FRANCIS E., with MYERS, J. ARTHUR, jt. auth.
HARRINGTON, STUART W., and CRAIG, WINCHELL McK. (ab.), Mediastinal and intraspinal perineural fibroblastoma (hour-glass or dumb-bell tumor) removed by one-stage operation, 760.
HARRIS, JOHN H., and PAYNE, FRANKLIN L. (ab.), Value of irradiation in treatment of ovarian carcinoma, 508, 639.
HARRISON, HARVEY T., Banquet address, Annual Meeting, Memphis, 616.
HARTUNG, ADOLPH, and RUBERT, SAMUEL R., Roentgen aspects of sympathetic neuroblastoma: with report of two cases, 607.
HASCHÉ, E., and COLLIER, W. A. (ab.), Influence of ultrashort electrical waves on malignant tumors, 124.
HASCHÉ, E., and LEUNIG, H. (ab.), Effect of short and ultrashort electric waves on anorganic and organic compounds, 517.
HAVLASEK, LUDVIK (ab.), Combination of radiation therapy with chemotherapy in carcinoma of uterus, 639.
HAWORTH, E. M. (ab.), Treatment of syringomyelia by x-rays, 648.
HEACOCK, C. H., and KING, J. CASH, Diagnosis of primary carcinoma of lung, 452.
HEATLEY, JOHN E., Calcification of splenic artery, 235.
HELD, A., and HÜLBACH, H. (ab.), Fibrinogen content of blood under influence of roentgen irradiation and primary effect of radiation, 386.
HENNY, GEORGE C., Artefacts in roentgen films, 350.
HENSHAW, P. S., Changes in susceptibility of *Drosophila* eggs to x-rays: correlations of biological activity and radiosensitivity, 438.
HERENDEEN, RALPH E., see BARRINGER, BENJAMIN S., jt. auth.
HERNAMAN-JOHNSON, F., Radiologist as physician (ed.), 116.
HERZOG, A., with GÜTIG, C., jt. auth.
HERZUM, HERBERT (ab.), Roentgen therapy of metastases of malignant tumors, 649.
HESSE, E. (ab.), Contribution to technic of radium application in cancers of rectum, 646.
HETHERINGTON, H. W. (ab.), Tuberculous lesions in children of school age, 129.
HIGLEY, CHARLES S., see FREEDMAN, EUGENE, jt. auth.
HIMLER, L. E., with WAGGONER, R. W., jt. auth.
HINTON, J. WILLIAM, and CHURCH, REYNOLD E. (ab.), Incidence of gastrojejunal ulcer following gastro-enterostomy, 645.
HINTZE, A. (ab.), Stubborn skin cancer and its cure, 124.
HIRSCH, I. SETH, and BAUM, SAMUEL M., Evaluation of roentgen treatment of laryngeal carcinoma: report of cases, 281.
HOHENNER, KARL (ab.), Early diagnosis of carcinoma of small intestine, 377.
HOLST, L. (ab.), Dilatation of pulmonary arch in roentgenologic cardiac silhouette: four cases of aneurysm of pulmonary artery, 642.
HOLST, L., with BEJUL, A., jt. auth.
HSIU, S. T., with GRAY, J., jt. auth.
HÜLBACH, H., with HELD, A., jt. auth.
HUMMEL, RUDOLF (ab.), Two cases of juvenile osteitis deformans Paget, 377.
HUTTON, JAMES H., Radiotherapeutic treatment of hypertension and diabetes, 330.
HYAMS, MORTIMER N. (ab.), Uterosalpingography by interrupted fractional injections: modified and improved technic, 642.

INGBER, EDMONDO (ab.), Radiologic study of luxation of semilunar bone, 520.
IRONS, ERNEST E. (ab.), Treatment of chronic arthritis: general principles, 505.
IVY, A. C., and BERGH, G. S. (ab.), Applied physiology of extra-hepatic biliary tract, 379.

JACKSON, CHEVALIER, and JACKSON, C. L. (ab.), Foreign bodies in intestines, 640.
JACKSON, C. L., with JACKSON, CHEVALIER, jt. auth.
JARRE, H. A., with GURDJIAN, E. S., jt. auth.
JEGOROW, BORIS (ab.), Roentgen therapy of carditis and aortitis, 515.
JEPKENS and LOEWENECK (ab.), Roentgenogram of hydronephrosis due to aberrant blood vessel, 514.
JONA, EUGENIA (ab.), Roentgen therapy of Flajani-Basedow's disease, 514.
JONES, ALFRED E., and ARENS, ROBERT A., Certain diagnostic phases of excretion urography, 169.
JONES, THOMAS E., with COLLINS, E. N., jt. auth.
JORDAN, SARA M., and KIEFER, EVERETT, D. (ab.), Complications of peptic ulcer: prognostic significance, 385.
JOVIN, J. (ab.), Purposes and significance of filtration in Coutard method, 639.
JOYCE, T. M. (ab.), Tumors of small intestine, 641.
JÜNGLING, O. (ab.), Fundamental principles of pre-operative irradiation, 257.
JURIS, K., with SMEREKER, H., jt. auth.

KAISER, R. (ab.), Lymphosarcoma of stomach and its cure by roentgen therapy, 259.
KANTOR, JOHN L. (ab.), Regional (terminal) ileitis: roentgen diagnosis, 512.
KANTOR, JOHN L., and SCHECHTER, SAMUEL (ab.), Colon studies: VII. Variations in fixation of cecocolon; their clinical significance, 510.
KAPLAN, IRA I., Modification of radiation treatment of carcinoma of stomach, 735.
KAPP, H. (ab.), Sclerosis of peripheral veins, 643.
KASAHARA, MICHIO (ab.), Diagnosis of lead poisoning in children, 643.
KAUFMAN, J., and LEVINE, I., Roentgenologic changes in transverse colon in peritoneal tuberculosis: case reports, 233.
KAUFMANN, WERNER (ab.), Cascade stomach, 257.
KEATING, EMMET, Fee tables and roentgenologists, 370.

KEICHLINE, JOHN M., Aid in determining position of uterus, 238.
KELLER, F. (ab.), Determination of radium isodose curves in r; corrections based on new experimental studies, 760.
KERR, H. DABNEY (ab.), Irradiation treatment of superficial malignancies, 639.
KIEFER, EVERETT D., with JORDAN, SARA M., jt. auth.
KIMBALL, FRANCIS N., with LOWSLEY, OSWALD S., jt. auth.
KIMBLE, H. E., Simplified mechanical method for radiographic mensuration and localization, 39.
KING, J. CASH, Relative value of radiotherapy, physical therapy, and hyperpyrexia in treatment of arthritic disturbances, 411.
KING, J. CASH, with HEACOCK, C. H., jt. auth.
KINSELLA, RALPH A., Medical aspects of chronic arthritis, 413.
KIRKLIN, B. R. (ab.), Duodenitis and roentgenologic characteristics, 512.
KIRKLIN, B. R., Some phases of roentgenologic diagnosis of gastric cancer (Carman Lecture), 672.
KIRKLIN, B. R., with GHORMLEY, RALPH K., jt. auth.
KIRKLIN, B. R., with RIVERS, ANDREW B., jt. auth.
KISS, NÁNDOR, and SZIRMAK, BELA (ab.), Parkinson's disease, 517.
KLEINBERG, SAMUEL (ab.), Osteogenesis imperfecta: report of two cases, 252.
KLÖVEKORN, G. H. (ab.), Epilation of rabbit skin following irradiation, 386.
KOCH, F. (ab.), Biologic experiments with Grenz rays, 382.
KORCHOW, W. I. (ab.), Complications following radium therapy of tumors of bladder and neighboring organs, 127.
KOROL, EPHRAIM, Rôle of force of gravity in pneumothorax cavity, including discussion of selective collapse, 550.
KRAUS, LEONARD (ab.), Roentgenologic diagnosis of mastoiditis, 385.
KREMSER, KURT (ab.), Multiple diverticula in cardiac end of stomach, 387.
KREMSER, KURT (ab.), Patella of elbow: contribution to anomalies of skeleton, 253.
KRUCHEN, C. (ab.), Roentgen therapy of erysipelas, 640.
KRUGLIKOWA, R. K., and WEISSBLATT, S. N. (ab.), Roentgen therapy in acute inflammatory diseases of mouth, 382.
KRUSE, FRED H. (ab.), Syndrome of hypertonic and atonic colopathy, 511.
KUGLER, G. A., with GLOCKER, R., jt. auth.
KUHN, HERMANN (ab.), "Peremesin" for prevention of x-ray sickness, 386.
KUKOWKA, A. (ab.), Roentgen therapy through small fields in deep-seated tumors, 125.
KURATSCHENKOW, A. J. (ab.), Treatment of erosions of uterus with roentgen and radium rays, 390.

LACASSAGNE, A. (ab.), Development of radiation therapy of uterine carcinoma, 260.
LAHM, W. (ab.), Observations on irradiated cases of thyrotoxicosis, 258.
LAMMERS, H. (ab.), Hyperintensive irradiation of certain types of carcinoma: preliminary report, 508.
LANG, A. (ab.), Radium therapy in malignant tumors of upper respiratory tract: results based on five years' observations, 386.
LANG, GUSTAV (ab.), Permeability of human skin for radium emanation in air, 647.
LANGE, F., with BRASCH, A., jt. auth.
LANGENDORFF, H., with GLOCKER, R., jt. auth.
LAUS, CLARK J., Irritable colon syndrome, 572.
LAW, FREDERICK M. (ab.), Roentgen examination of mastoid processes, 516.
LAZARUS, JOSEPH A. (ab.), Carbuncle of kidney, 254.
LE FLEMING, E. KAYE (ab.), Radiology as aid to general practitioner, 257.
LENZ, MAURICE, with MARTIN, HAYES E., jt. auth.
LEONARD, RALPH D., with GEORGE, ARIAL W., jt. auth.
LEPESCHKIN, W. W. (ab.), Influence of sunlight on red blood corpuscles of man *in vivo*, 130.
LEROUX, LOUIS, with FORESTIER, JACQUES, jt. auth.
LEUCUTIA, T. (ab.), Irradiation in lymphosarcoma, Hodgkin's disease, and leukemia: statistical analysis, 126.
LEUCUTIA, T., and CORRIGAN, K. E. (ab.), Present status of roentgen therapy with voltages above 200 K.V.: technical development and medical application, 506.
LEUNIG, H., with GERICKE, W., jt. auth.
LEUNIG, H., with HASCHÉ, E., jt. auth.
LEVENE, GEORGE, WHEATLEY, FRANK E., and MATTHEWS, HELEN (ab.), Roentgen diagnosis of coronary disease, 515.
LEVIN, ALFRED G., with SWENSON, PAUL C., jt. auth.
LEVINE, I., with KAUFMAN, J., jt. auth.
LEVINE, SAMUEL, with SOLIS-COHEN, LEON, jt. auth.
LEWIS, JOHN S., Jr., with BAKER, EDGAR C., jt. auth.
LIEBER, G. D. (ab.), Physico-chemical effect of roentgen rays on organism, 759.
LINDON, LEONARD C. E. (ab.), Ventriculography in diagnosis of intracranial tumor, 649.
LIVINGSTON, M. STANLEY, see STONE, ROBERT S., jt. auth.
LOB, A. (ab.), Roentgenologic investigation of results of suturing of perforated gastric and duodenal ulcers, 644.
LOEWENECK, with JEPKENS, jt. auth.
LOVE, JESSHILL, with YOUNG, WILLIAM J., jt. auth.
LOWSLEY, OSWALD S., and KIMBALL, FRANCIS N. (ab.), Sarcoma of prostate, 517.
LÜDIN, M., and BADER, A. (ab.), Roentgen therapy of posttraumatic cyst of iris, 379.
LUTTEKEN, W., with SCHULTE, G., jt. auth.

McCARTHY, JUSTIN E., see BROWN, SAMUEL, jt. auth.
McCREA, E. D'ARCY, and McDONALD, A. D. (ab.), Pre-sacral sympathectomy and urinary bladder, 253.
McDONALD, A. D., with McCREA, E. D., jt. auth.
McDONALD, HAROLD P., see BALLENGER, EDGAR G., jt. auth.
MacFARLAND, W. JAMES, Carcinoma of stomach in girl 21 years of age, 494.
McGUFFIN, W. H., Colonic lesion, 114.
McPHEDRAN, F. MAURICE (ab.), Tuberculous and non-tuberculous pulmonary infections in infancy and childhood, 129.
MACDONALD, D. O., with FRIEDMAN, J., jt. auth.
MARCHBANKS, S. S., with BALL, ROBERT P., jt. auth.
MARTIN, HAYES E., and LENZ, MAURICE, Symposium on treatment of pharyngeal cancer by divided or protracted dose principle of external radiation (ed.), 364.
MARTIUS, H. (ab.), Intravaginal irradiation at close range of carcinoma of cervix, 260.
MATTHEWS, HELEN, with LEVENE, GEORGE, jt. auth.
MAXWELL, JAMES, see CHANDLER, F. G., jt. auth.
MAYER, ERNST G. (ab.), Anomalies in position of planum sphenoidale and their diagnostic significance, 518.
MEAKINS, J. C. (ab.), Dyspnea, 518.
MELAND, ORVILLE N., Intra-oral cancer and its treatment, 276.
MELAND, ORVILLE N., with MUDD, SEELEY G., jt. auth.
MELCHART, FRANZ (ab.), Treatment of lymphogranulomatosis with high doses of roentgen rays, 760.
MELCHART, FRANZ, and SCHLOSS, WILHELM (ab.), Simultaneous radium and roentgen therapy of carcinoma of breast, 507.
MELCHART, FRANZ, with ROSENFELD, PETER, jt. auth.
MENVILLE, L. J., and ANÉ, J. N. (ab.), Roentgen study of absorption by lymphatics of thorax and diaphragm of thorium dioxide injected intrapleurally into animals, 256.
MENVILLE, L. J., ANÉ, J. N., and BLACKBERG, S. N., X-ray experimental studies showing that rachitic rats with healed bone lesions continue to show alteration in their gastrointestinal tract, 74.
MERCIER, OSCAR (ab.), Personal technic for cure of epispadias in women, 515.
MERRITT, E. A., and RATHBONE, R. RHETT, Treatment of epithelioma involving cartilage using 220 K.V.P. and heavy filtration, 701.
MESTERN, JÜRGEN (ab.), Hereditary synostoses of small bones of hand and foot: hereditary *os tibilae externum*, 390.
MEYER, WILLIAM H., Importance of roentgen gastric functional study in differential diagnosis of pyloric lesions, 206.
MEYTHALER, F., with BERNER, F., jt. auth.
MINTZ, E. R. with BARNEY, J. D., jt. auth.
MITCHELL, JOSEPH I., Bone lesions in children, 715.
MONAUNI, J. (ab.), Roentgen diagnosis of pancreatic cysts, 644.
MOORE, JOHN J. (ab.), Myocardial calcification, 515.
MOORE, JOHN J., and de LORIMIER, ALFRED A., (ab.), Roentgenographic studies of parathyroid deossification, 376.
MOORE, JOHN R., with WOHL, MICHAEL G., jt. auth.
MUDD, SEELEY G., EMERY, CLYDE K., MELAND, ORVILLE N., and COSTOLOW, WILLIAM E. (ab.), Data concerning three years' experience with 600 K.V. (peak) roentgen therapy, 507.
MÜLLER, ROLAND (ab.), Radium treatment of carcinoma of vocal cords by "window" method, 645.
MURPHY, J. E. (ab.), Bronchography, essential and safe adjunct in study of pulmonary tuberculosis, 388.
MYERS, J. ARTHUR (ab.), Artificial pneumothorax, 759.
MYERS, J. ARTHUR, and HARRINGTON, FRANCIS E. (ab.), Effect of initial tuberculous infection on subsequent tuberculous lesions, 388.

NAHMMACHER, F. (ab.), Chemotherapy as supplementary treatment in radiation therapy of malignant disease, 125.
NEEFF, T. C. (ab.), Advances in standardization of practical dosage in roentgen and radium therapy, 379.
NOLTE, F. A. (ab.), Changes of cardiac contour and size, produced by increased intra-pulmonary pressure, investigated cardio-kymographically. (Cardio-kymograms during Valsalva experiments.), 126.
NORDENTOFT, JACOB (ab.), Intestinal invagination in children, 642.
NURNBERGER, CARL E., with STENSTROM, WILHELM, jt. auth.

OBERHOLZER, J. (ab.), Pneumoradiograms of knee joint, 383.
O'BRIEN, FREDERICK W., Roentgen therapy in syringomyelia, 16.

OLSCHANOWSKYI, E. I., with DUBOWYI, E. D., jt. auth.
OTT, PAUL, with ERNST, H. W., jt. auth.

PALMSTIERNA, KULE (ab.), Nourishment in cases of radiological reaction in mucous membranes of mouth and throat, 649.
PALUGYAY, J. (ab.), Contribution to etiology and roentgen diagnosis of bone sarcoma, with remarks concerning "osteo-arthropathie hypertrophiante pneumique," 123.
PALUGYAY, J., and PESEK, G. (ab.), Disturbed peristalsis of esophagus, with formation of pseudo-diverticula, 509.
PAPE, R. (ab.), Concerning question of roentgenologically demonstrable gastric mucosal atrophy in pernicious anemia, 645.
PAPE, R. (ab.), Roentgen therapy of diseases of blood, 637.
PARISEL, C. (ab.), Two cases of congenital atrophy of thumb: reconstruction by bone graft, 637.
PARKER, GEOFFREY E. (ab.), Fatal gonococcal pyemia following internal urethrotomy, 513.
PAUL, L. W., Diverticula of fundus of stomach, 47.
PAYNE, FRANKLIN L., with HARRIS, JOHN H., jt. auth.
PEARSON, GERTRUDE R., Technic for use of small cone in check radiographs of spine, 601.
PEIRCE, CARLETON BARNHART, Extra-pulmonary tumors of thorax, 467.
PENDERGRASS, EUGENE P., and ALLEN, M. LOWRY (ab.), Congenital cardiac disease in infants, with discussion of tracheal displacmenet as roentgen sign, 515.
PENNINGTON, WALTER E., X-ray study of gastric rugæ, 221.
PERRY, S. PAUL, Experiences in irradiation treatment of hyperthyroidism, 326.
PESEK, G., with PALUGYAY, J., jt. auth.
PFAHLER, GEORGE E. (ab.), Roentgen diagnosis of mediastinal tumors and their differentiation, 389.
PFAHLER, GEORGE E., Treatment of epithelioma of cheek, 99.
PHEMISTER, D. B. (ab.), Fractures of neck of femur, dislocations of hip, and obscure vascular disturbances producing aseptic necrosis of head of femur, 253.
PHILLIPS, CHARLES, Osteogenic sarcoma: pathologic characteristics, 728.
PILLMORE, GEORGE U., Future of radiology (ed.), 749.
PINNER, MAX (ab.), Hematogenous (non-miliary) pulmonary tuberculosis, 388.
PODLASKY, H. B., Biliary colic fistula, 345.
POHL, R. (ab.), Interlobar pneumothorax, 640.
POHLE, ERNST A., and RITCHIE, GORTON (ab.), Histological studies of liver, spleen, and bone marrow in rabbits following intravenous injection of thorium dioxide, 378.
POHLE, ERNST A., and RITCHIE, GORTON, Malignant tumors of kidney in children, with report of six cases, 193.
POPP, L. (ab.), Case of sarcoma of prostate cured by roentgen therapy, 386.
POTTER, B. P. (ab.), Bronchography in relation to pathology of pulmonary tuberculosis, 388.
PRÉVOT, R. (ab.), Roentgen diagnosis of intermittent ileus, 381.
PROBST, V., with DIETEL, F. G., jt. auth.

QUICK, DOUGLAS (ab.), Management of cancer of mouth and cervical lymphatics, 377.

RADDING, M. B., Schüller-Christian disease after x-ray therapy, living and under observation eleven years, 591.
RATHBONE, R. RHETT, with MERRITT, E. A., jt. auth.
REHFUSS, MARTIN E. (ab.), Proteins *versus* carbohydrates: inquiry into their gastric digestion, 381.
REINHARD, M. C. (ab.), Variations in dosage dependent on wave length, 509.
REINHARD, M. C., and GOLTZ, H. L., Simultaneous multiple field irradiation with 4.5-gram radium pack, 315.
REIPRICH, W. (ab.), Results in treatment of carcinoma of cervix by Women's Clinic of University of Breslau, 390.
RHINEHART, B. A., Increased irritability of gastro-intestinal tract: discussion of disturbed physiology, 1.
RIEBEL, FRANK A., Shall we tell a cancer patient the truth? (ed.), 496.
RITCHIE, GORTON, with POHLE, ERNST A., jt. auth.
RIVERS, ANDREW B., STEVENS, G. ARNOLD, and KIRKLIN, B. R. (ab.), Diverticula of stomach, 647.
ROBINSON, W. W., Composite unit for sinus-mastoid and gastro-duodenal radiography, 235.
ROSE, D. K. (ab.), Postpartum pyelitis of pregnancy: treatment of certain cases without use of ureteral catheter: explanation based on physiology of bladder, 382.
ROSENFELD, PETER, and MELCHART, FRANZ (ab.), Construction of small ionization chambers without directional effect and their use in roentgen dosimetry, 640.
ROSH, RIEVA, with FRIEDMAN, MILTON, jt. auth.
RUBERT, SAMUEL R., with HARTUNG, ADOLPH, jt. auth.
RYPINS, EDWIN L. (ab.), Roentgen ray as aid in diagnosis of hemophilia, 516.

SAITO, T. (ab.), Cytologic study of living body irradiated with hard ray. Part I, Influence of hard ray upon development of beans and abnormality of nuclei and cell division, 127.
SARASIN, R. (ab.), Reactions in skin and mucous membrane following protracted fractional roentgen therapy, 518.
SCHAMBYE, GRETHE, with UHLMANN, ERICH, jt. auth.
SCHECHTER, SAMUEL, with KANTOR, JOHN L., jt. auth.
SCHENCK, SAMUEL GEORGE, and STEIN, JACOB L., Congenital lung cysts in infants and children, 420.
SCHLIEPHAKE, ERWIN (ab.), Therapy with short electric waves, 650.
SCHLOSS, WILHELM, with MELCHART, FRANZ, jt. auth.
SCHMIDT-LA BAUME, F., with GENTNER, W., jt. auth.
SCHNEIDER, JUSTUS (ab.), Importance of roentgenologic examination for diagnosis and treatment of gas gangrene of extremity, 380.
SCHOLZ, THOMAS (ab.), Solution of roentgen diagnostic problem in chronic appendicitis: conclusions based upon studies covering a period of twenty years and including a comparative analysis of roentgenological, clinical, surgical, and post-mortem findings, 505.
SCHOONOVER, JANETTA WRIGHT, SHIELS, ETHOL HALL, and WIDMANN, BERNARD P. (ab.), Alterations in P_H of blood in cancer following roentgen and gamma irradiation, 378.
SCHROEDER, C. (ab.), Our results in treatment of carcinoma of ovary, 256.
v. SCHUBERT, E. (ab.), Preliminary report concerning our three years' experience in cancer therapy with extremely hard roentgen rays, 124.
SCHULTE, G. (ab.), Ten years' experience with roentgen therapy in non-malignant disease of tonsils in over 1,000 patients, 258.
SCHULTE, G., and LUTTEKEN, W. (ab.), Experience with Fichera method in carcinoma therapy, 639.
SEARS, NATHAN P. (ab.), Treatment of unilateral urinary fistulas by x-ray destruction of kidney: clinical and experimental study, 383.
SEYLER, I. EVERETT, see BALYEAT, RAY M., jt. auth.
SHEPLEY, E. E. (ab.), Rôle of radiotherapy in problem of malignancy, 639.
SHIELS, ETHOL HALL, with SCHOONOVER, JANETTA WRIGHT, jt. auth.
SHOEMAKER, H. A., see BALYEAT, RAY M., jt. auth.
SHUTES, M. H. (ab.), Cured carcinoma of nose and antrum, 638.
SIMON, E. (ab.), Technic of saliography, 518.
SIMONSEN, MARTIN (ab.), Benign tumors of stomach, 387.
SINGER, K., see CANIGIANI, T., jt. auth.
SINKOE, SAMUEL J., FOWLER, MAJOR F., and BERGER, LOUIS (ab.), Wilms tumor of kidney, 255.
SLOAN, DAVID H., see STONE, ROBERT S., jt. auth.
SMEREKER, H., and JURIS, K. (ab.), Measurement of beta rays of radium in r units, 646.
SMITH, A. J. D. (ab.), Use of radium in carcinoma of bladder, 127.
SMITH, DAVID T. (ab.), Diagnosis and treatment of pulmonary abscess in children, 255.
SMITH, FRANK R. (ab.), Incidence of vaginal fistulæ in patients with carcinoma of cervix, 125.
SMITH, LESTER A., Xanthomatosis involving bone (lipoid histiocytosis): case reports and roentgen findings, 521.
SMITH, R. MANGES, with FETTER, THEODORE R., jt. auth.
SOILAND, ALBERT, Social and economic aspects of cancer, 213.
SOLIS-COHEN, LEON, and LEVINE, SAMUEL (ab.), Bone and joint changes in hemophilia, 382.
SOLOMON, L., with GIBERT, P., jt. auth.
SOSTMANN, H. (ab.), Usefulness of decomposition of H_2O_2 as measuring reaction in ultra-violet light dosimetry, 130.
SPITZENBERGER, O. (ab.), Diagnosis of lymphosarcoma of stomach, 387.
STECHER, WILLIAM R., with WIDMANN, BERNARD P., jt. auth.
STEIN, JACOB L., with SCHENCK, SAMUEL GEORGE, jt. auth.
STENSTROM, WILHELM, and NURNBERGER, CARL E., Semiautomatic implant-cutter, 562.
STEVENS, G. ARNOLD, with RIVERS, ANDREW B., jt. auth.
STEVENS, J. THOMPSON, Preliminary or pre-operative and pre-radium irradiation in management of malignant diseases, 739.
STEWART-HARRISON, R. (ab.), Field of application for radium, 127.
STEWART-HARRISON, R. (ab.), Treatment of Ewing's sarcoma: results in Zürich, 646.
STONE, ROBERT S., LIVINGSTON, M. STANLEY, SLOAN, DAVID H., and CHAFFEE, MILTON A., Radio frequency high voltage apparatus for x-ray therapy, 153, 298.
SUSSMAN, MARCY L., Inflammation of descending portion of duodenum: preliminary report, 691.
SWAIM, LORING T. (ab.), Orthopedic and physical therapeutic treatment of chronic arthritis, 505.
SWENSON, PAUL C., and LEVIN, ALFRED G. (ab.), Primary carcinoma of duodenum: case report, 378.
SZIRMAK, BELA, with KISS, NANDOR, jt. auth.

THORAEUS, R. (ab.), Experimental investigations of some dosage conditions in technic of roentgen treatment used in Sweden, 640.
TROSTLER, I. S., How long are we liable? Physician sued for alleged fluoroscopic burn after sixteen years, 500.
TROSTLER, I. S., Some remarks regarding medical expert witness and personal injury suit situation, 567.

TUCKER, GABRIEL (ab.), Method of roentgen localization of foreign bodies in stomach prior to gastroscopic removal, 510.

UDE, WALTER H., and URNER, JOHN A. (ab.), Roentgenologic diagnosis of placenta previa, 514.
UDVARDY, LADISLAUS (ab.), Mediastinal pleurisy, 386.
UDVARDY, LADISLAUS (ab.), Round shadows in lungs, 384.
UHLMANN, ERICH, and SCHAMBYE, GRETHE (ab.), Successful treatment of radiation injuries of skin, 638.
URNER, JOHN A., with UDE, WALTER H., jt. auth.

VAN BUSKIRK, E. M., Graphical method for obtaining area of heart shadow in roentgen-ray study of heart disease, 433.
VASILIU, ALEXANDER, with GRIGORESCU, ION, jt. auth.
VASTINE, JACOB H. (ab.), Diverticulum of gall bladder, 510.
VASTINE, JACOB H., and BACON, EMILY P., Osteitis tuberculosa multiplex cystica, with report of two cases, 22.
VISCHIA, QUINTINO (ab.), Sialolithiasis of maxillary glands, 252.
VOGT, E. (ab.), Experience with short wave therapy in gynecology, particularly in tumors of adnexa, 253.
VOLTZ, F. (ab.), Radiation therapy of uterine carcinoma, 260.

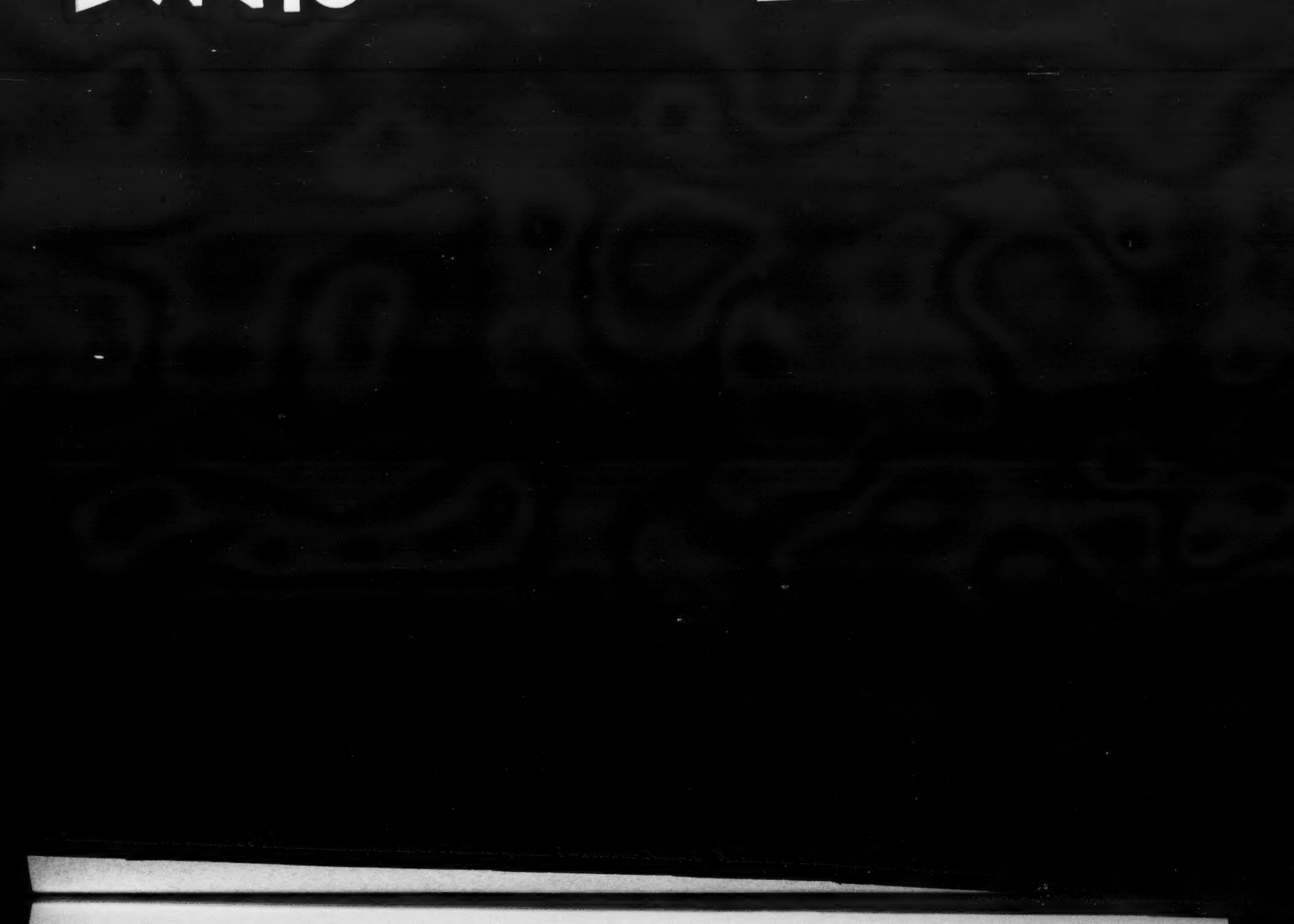
WACHNER, GERHARD (ab.), Varices of esophagus, 640.
WAGGONER, R. W., and HIMLER, L. E. (ab.), Encephalography under nitrous oxide anesthesia, 509.
WALTERS, WALTMAN (ab.), Treatment of extensive malignant lesions of stomach, 519.
WALTZ, HAROLD D., with ALLEN, KENNETH D. A., jt. auth.
WATKINS, KENNETH H. (ab.), Clinical value of bladder pressure estimations, 253.
WEBER, HARRY M. (ab.), Roentgen diagnosis of diseases of colon: evaluation of methods, 513.
WEISKOTTEN, W. O., Simple method of making serial films with Potter-Bucky diaphragm, 625.
WEISSBLATT, S. N., with KRUGLIKOWA, R. K., jt. auth.
WEYERBACHER, A. F., and BALCH, JAMES F. (ab.), Granuloma of bladder, 514.
WHEATLEY, FRANK E., with LEVENE, GEORGE, jt. auth.
WHITE, MARGARET MOORE (ab.), Congenital absence of one kidney, 516.
WHITE, RICHARD JOSEPH (ab.), Traumatic interstitial hernia of bladder, 514.
WIDMANN, BERNARD P., and STECHER, WILLIAM R., Rhizomonomelorheostosis, 651.
WIDMANN, BERNARD P., with SCHOONOVER, JANETTA WRIGHT, jt. auth.
WILLIAMS, NORMAN H. (ab.), Comparison of clinical and x-ray pelvimetry, 644.
WILLIAMSON, W. L., Proposed sickness insurance (ed.), 632.
WILLIS, HENRY STUART (ab.), Specificity of pulmonary consolidation in tuberculous patients (epituberculosis): resolution of experimental tuberculous pneumonia, 519.
WILSON, R. T., Osteogenic sarcoma: roentgenologic characteristics, 708.
WINKLER, K., with BARSONY, T., jt. auth.
WINSBURY-WHITE, H. P. (ab.), Review of 162 consecutive personal cases of stone in upper urinary tract, 253.
WINTZ, H. (ab.), Supplementary radium treatment in roentgen therapy of uterine carcinoma, 260.
WITWER, E. R., with EVANS, WILLIAM A., jt. auth.
WOHL, MICHAEL G., MOORE, JOHN R., and YOUNG, BARTON R., Basophilic adenoma (pituitary basophilism): report of case, with clinical improvement of systemic manifestations after irradiation of pituitary, 53.

YENIKOMSHIAN, H. A., and BLAKE, H. K., Familial bony dystrophy with multiple exostoses, 623.
YOUNG, BARTON R., with WOHL, MICHAEL G., jt. auth.
YOUNG, WILLIAM J., and LOVE, JESSHILL, Simple method for estimating loss of r units following x-ray treatment, 110.

ZEITLIN, A., Some reflections on etiology of Köhler's disease, 360.
ZEITLIN, A. (ab.), Unilateral periosteal thickening of metatarsals, 379.
ZIMMER, EMIL A. (ab.), Gallstones and their diagnosis in gall bladder not filled by dye, 380.
ZIMMER, K. G. (ab.), Relation between x-ray dosis and rate of mutation, 126.

DISCUSSANTS

ANSPACH, WILLIAM E. (Symposium on Thoracic Neoplasms), 492.
BAKER, CHARLES F. (Symposium on Ductless Glands), 343.
BARROW, S. C. (Symposium on Ductless Glands), 343.
BAUM, SAMUEL M. (Symposium on Mouth and Neck), 296.
CAMPBELL, WILLIS C. (Symposium on Chronic Arthritis), 419.
CAMPBELL, WILLIS C. (Symposium on Bone Tumors), 733.
CUTLER, MAX (Symposium on Mouth and Neck), 294.
DERR, JOHN S. (Symposium on Mouth and Neck), 295.
DUBROW, J. L. (Symposium on Thoracic Neoplasms), 492.
FORESTIER, JACQUES (Symposium on Chronic Arthritis), 418.
GARLAND, L. H. (Symposium on Mouth and Neck), 297.
HENNESSEY, RUSSELL A. (Symposium on Urology), 203.
HUBENY, M. J. (Symposium on Ductless Glands), 341.
HUTTON, JAMES H. (Symposium on Ductless Glands), 341.
JONES, A. E. (Symposium on Urology), 205.
KAHN, MAX (Symposium on Bone Tumors), 731.
LAWRENCE, W. S., 742.
LIVERMORE, GEORGE (Symposium on Urology), 204.
MELAND, ORVILLE N. (Symposium on Mouth and Neck), 296.
MITCHELL, J. I. (Symposium on Bone Tumors), 734.
NICHOLS, B. H. (Symposium on Urology), 203.
PERRY, S. PAUL (Symposium on Ductless Glands), 343.
PINDELL, M. L. (Symposium on Bone Tumors), 734.
POHLE, ERNST A. (Symposium on Urology), 203.
RIGLER, LEO G. (Symposium on Thoracic Neoplasms), 488.
RIGLER, LEO G., *see under* Esophagus (Brown and McCarthy).
SMITH, LESTER A. (Symposium on Bone Tumors), 734.
STONE, ROBERT S. (Symposium on Chronic Arthritis), 418.
STONE, ROBERT S. (Symposium on Mouth and Neck), 295.

COUNSELORS FOR 1935

CANADA		
Alberta	Bernard R. Mooney, M.D., 539 Tegler Bldg.	Edmonton
British Columbia	C. W. Prowd, M.D., St. Paul's Hospital	Vancouver
Manitoba	C. H. Burger, M.D., 514 Boyd Bldg.	Winnipeg
New Brunswick	Archibald S. Kirkland, M.D., General Public Hospital	St. John
Ontario	Hermann E. Schaef, M.D., 1225 Dundas St.	London
Quebec	Leo E. Pariseau, M.D., 361 Mount Royal Ave., West	Montreal
Saskatchewan	Clarence M Henry, M.D., 415 McCallum-Hill Bldg.	Regina
CUBA		
Cuba	Juan Manuel Viamonte, 64 A. Concordia St.	Havana
MEXICO		
Mexico	Manuel F. Madrazo, M.D., Napoles No. 19	Mexico City
UNITED STATES		
Alabama	James A. Meadows, M.D., 1207 Empire Bldg.	Birmingham
Arizona	H P. Mills, M.D., 727 E. McDowell St.	Phoenix
Arkansas	Charles H. Nims, M.D.	Hot Springs
California	Robert R. Newell, M.D., Stanford Hospital	San Francisco
	William E. Costolow, M.D., 1407 S. Hope St.	Los Angeles
Colorado	Kenneth D. A. Allen, M.D., 452 Metropolitan Bldg.	Denver
Connecticut	Ralph T. Ogden, M.D., 179 Allyn St.	Hartford
Delaware	George C. McElfatrick, M.D., 1024 W. 8th St.	Wilmington
Dist. of Columbia	Joseph Francis Elward, M.D., 1726 Eye Street, N. W.	Washington
Florida	Wilfred McLaurin Shaw, M.D., 418 St. James Bldg.	Jacksonville
Georgia	James J. Clarke, M.D., 384 Peachtree St.	Atlanta
Idaho	Charles V. Genoway, M.D., 615 Eastman Bldg.	Boise
Illinois	George M. Landau, M.D., 660 Groveland Park	Chicago
	Perry B. Goodwin, M.D., 211 Pacific Ave.	Peoria
Indiana	Lawrence F. Fisher, M.D., 825 Sherland Bldg.	South Bend
	Charles Wyeth, M.D., 416 Tribune Bldg.	Terre Haute
Iowa	Harold A. Spilman, M.D., Hofmann Block	Ottumwa
Kansas	L. G. Allen, M.D., 704 Commercial Bldg.	Kansas City
Kentucky	I. T. Fugate, M.D., 309 Francis Bldg.	Louisville
Louisiana	Lester James Williams, M.D., Reymond Block	Baton Rouge
Maine	Edson S. Cummings, M.D., 12 Pine St.	Portland
Maryland	Max Kahn, M.D., 2 West Read St.	Baltimore
Massachusetts	Merrill C. Sosman, M.D., 721 Huntington Ave.	Boston
Michigan	Offley J. Shore, 552 Fisher Bldg.	Detroit
Minnesota	Gage Clement, M.D., St. Luke's Hospital	Duluth
Mississippi	Little Berry Neal, M.D., Lamar Life Bldg.	Jackson
Missouri	Paul F. Titterington, M.D., 212 Metropolitan Bldg.	St. Louis
Montana	Fred F. Attix, M.D., 618 W. Main St.	Lewistown
Nebraska	Howard B. Hunt, M.D., University of Nebraska	Omaha
Nevada	James Thom, M.D., 308 N. Curry St.	Carson City
New Hampshire	Merrill C. Sosman, M.D., 721 Huntington, Ave.	Boston, Mass.
New Jersey	George Styles Reitter, M.D., 144 Harrison Street	East Orange
New Mexico	John R. Van Atta, M.D., First National Bank Bldg.	Albuquerque
New York	Alfred L. L. Bell, M.D., Long Island College Hospital	Brooklyn
	Roger Scott, M.D., 598 Pine Street	Niagara Falls
North Carolina	Robert H. Lafferty, M.D., Charlotte Sanatorium	Charlotte
North Dakota	T. P. Rothnem, M.D., Fargo Clinic	Fargo
Ohio	E. R. Bader, M.D., 628 Elm St.	Cincinnati
	E. P. McNamee, M.D., 670 Hanna Bldg.	Cleveland
Oklahoma	Morris Lhevine, M.D., 1007 Medical Arts Bldg.	Tulsa
Oregon	Frank E. Butler, M.D., 242 Medical Arts Bldg.	Portland
Pennsylvania	John M. Keichline, M.D., 820 Fifth St.	Huntingdon
	John T. Farrell, Jr., M.D., 235 S. 15th St.	Philadelphia
	Zoe A. Johnston, M.D., 601 Jenkins Bldg.	Pittsburgh
Rhode Island	Isaac Gerber, M.D., 126 Waterman St.	Providence
South Carolina	Floyd D. Rodgers, M.D., 1417 Hampton St.	Columbia
South Dakota	N. J. Nessa, M.D., Sioux Falls Clinic	Sioux Falls
Tennessee	Charles H. Heacock, M.D., 20 S. Dunlap Street	Memphis
Texas	Rabun T. Wilson, M.D., Scott and White Clinic	Temple
	George Turner, M.D., 913 First National Bank Bldg.	El Paso
	Winfield G. McDeed, M.D., 1103 Medical Arts Bldg.	Houston
Utah	James P. Kerby, M.D., 325 Boston Bldg.	Salt Lake City
Vermont	B. F. Cook, Rutland Hospital	Rutland
Virginia	Fred M. Hodges, M.D., 1000 W. Franklin St.	Richmond
Washington	M. F. Dwyer, M.D., Virginia Mason Hospital	Seattle
West Virginia	Lonzo O. Rose, M.D., 510½ Market St.	Parkersburg
Wisconsin	Frank W. Mackoy, M.D., Sacred Heart Sanitorium	Milwaukee
Wyoming	C. A. Conyers, 214 Boyd Bldg.	Cheyenne
ARMY AND NAVY		
Army	Henry C. Pillsbury, M.D., Walter Reed Hospital	Washington, D. C.
Navy	Capt. Thomas W. Raison, M.C., Naval District	Mare Island Calif.